Public Documents of Massachusetts:

BEING THE

ANNUAL REPORTS

OF VARIOUS

PUBLIC OFFICERS AND INSTITUTIONS

FOR THE YEAR

1897.

PUBLISHED BY THE SECRETARY OF THE COMMONWEALTH.

Vol. IX.

BOSTON:
WRIGHT & POTTER PRINTING CO., STATE PRINTERS,
18 POST OFFICE SQUARE.
1898.

PUBLIC DOCUMENTS

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PUBLIC DOCUMENT . . . . No. 4.

FORTY-FIFTH

ANNUAL REPORT OF THE SECRETARY

OF THE

MASSACHUSETTS

STATE BOARD OF AGRICULTURE,

TOGETHER WITH THE

TENTH ANNUAL REPORT OF THE HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE.

1897.

BOSTON:
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	Term Expires
JAMES S. GRINNELL of Greenfield,	1899
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Massachusetts Horticultural,	E. W. WOOD of West Newton,	1900
Massachusetts Society for Promoting Agriculture,	N. I. BOWDITCH of Framingham,	1900
Middlesex North,	JOSHUA CLARK of Tewksbury,	1901
Middlesex South,	ISAAC DAMON of Wayland (P. O. Cochituate),	1899
Nantucket,	J. S. APPLETON, Jr., of Nantucket,	1900
Oxford,	J. W. STOCKWELL of Sutton,	1901
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Weymouth (Agr'l and Ind'l),	QUINCY L. REED of South Weymouth,	1900
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Worcester South,	C. D. RICHARDSON of West Brookfield,	1901
Worcester County West,	E. A. HARWOOD of North Brookfield,	1899

THE FORTY-FIFTH ANNUAL REPORT

OF THE

SECRETARY

OF THE

BOARD OF AGRICULTURE.

To the Senate and House of Representatives of the Commonwealth of Massachusetts.

Replies received the last of May from 190 crop correspondents indicated that the season of 1897 opened from one to two weeks earlier than usual; but that the cold, wet weather, while having an excellent effect on vegetation, tended to reduce the progress of the season more nearly to the normal. The season seemed to be relatively earlier in the western sections than in those nearer to the coast. All crops were reported well advanced and making a good growth. Not for several years were the early reports in regard to pastures and mowings so favorable. Copious rains gave both a good start, and grass was everywhere thick and strong. Fall seeding generally wintered well, and the spring rains aided it in securing a good start. Apples made a remarkably full bloom, considering the heavy crop of last year; early varieties blooming more fully than did winter ones. Pears, plums, cherries and quinces made a full average bloom. The peach bloom could hardly be called full, although still much above the usual bloom for this section. Small fruits and wild berries generally blossomed well. Rather less damage than usual was reported from insects. Tent caterpillars were the most common, but appeared to be doing rather less damage than usual. A new imported insect pest, the brown-tail moth, was reported as doing much damage to pear trees in portions of Somerville and Cam-

bridge. Spraying was reported as not practised to any extent, except by those who make fruit growing a specialty. Farm help was reported as plenty in most localities, though considerable complaint was made of the difficulty of securing really good help. Wages averaged about $18 per month, with board. For day help the range reported was from $1 to $2 per day. The usual price paid in most localities, except in haying and harvesting time, was $1.25. Most correspondents reported that there were no marked changes in the acreage of farm crops. Rather more corn than usual was planted, the increase being mostly for the silo.

In June, considerable complaint was made of the failure of corn to germinate, necessitating replanting or abandonment of fields. Acreage of early potatoes about as in previous years, and the crop generally promised well, though somewhat backward. Early market-garden crops late and growing slowly, but where harvested the yield was usually spoken of as satisfactory. Prices ruled about as usual, with perhaps a slight upward tendency for some crops. There appeared to be a slight increase in the sum total of dairy products, probably due to the excellent feed in pastures. There was a surplus of milk in many sections. Supply of dairy stock, on the whole, none too great for the demand. Strawberries were generally said to be a good crop, with prices average, but the quality of the early berries suffered somewhat from the wet weather and lack of sun, and the crop was generally delayed in ripening.

In July, squash bugs, both the black and the striped varieties, appeared to be rather more numerous than usual. Indian corn was very backward, with color off and stand uneven. Reports from all quarters agreed that the hay crop was one of the largest ever known in the State; the quality was also said to be excellent, as a rule, though trouble was reported in some sections from the presence of weeds, which throve unduly during the wet weather. Market-garden crops suffered more or less from the severe rains. Considerable complaint was made of potato blight. Prices for early potatoes generally spoken of as much better than for several seasons past. Rye was a good crop, if anything, a little above the average.

In August, Indian corn was still backward. Rowen promised to be the best crop for many years. Late potatoes were very poor, with blight general throughout the State; rot also generally prevalent. Tobacco suffered from the excessive rains, and was reported as mostly late, yellowish in color and small in growth. Pastures were everywhere in fine condition. Oats and barley were hardly up to the average where allowed to mature the grain, and there was considerable complaint of rust and lodging, also of grain not being as full and plump as usual. Oats and barley did very well indeed where sowed for forage.

In September, the corn crop materially improved in condition, but at cutting time considerable complaint was made that it had not eared well, and also that the ears were not well filled out. Sweet corn was also below the average. Rowen was an unusually good crop, many correspondents speaking of it as the best crop ever known, and it was secured in good condition. Fall feed was also above the average in condition, and promised to hold out well. Onions were considerably less than an average crop; rot was reported in some sections, and there was some complaint of big necks. The potato crop was one of the poorest for many years, many correspondents speaking of it as hardly worth digging. Potato rot was general throughout the State on all but the lightest lands, and on many fields it destroyed almost the entire crop. There was also much complaint of the tubers being small and few. Pears were very abundant, and were generally of good quality. Peaches made a better yield than usual, and were mostly of large size and fair quality. Grapes yielded well, but were late. Plums were generally a good crop, though there was quite a good deal of complaint of their rotting on the trees, as was also the case with other tree fruits. Cranberries were only a fair crop.

In October, root crops were reported hardly up to the usual average. Celery, where reported on, was generally said to have done well. Farm stock everywhere was in fine condition. Early sown fall seeding was generally reported to have made a good catch, but less than the usual amount was done, owing mainly to the ground being too dry to give good promise of success. In regard to prices, it may be

said that there appeared to be a general improvement in prices paid for farm crops over those of recent years.

As to the profit from farm crops during the year 1897, it may be said that the returns of correspondents November 1 showed a great diversity of opinion. One hundred and three of the 162 correspondents making reply considered hay to have been among the most profitable crops; 22, corn; 17, potatoes; 13, sweet corn; 9, onions; 8, tobacco; 7, cabbage; 6, winter squash; 5 each of milk, asparagus and strawberries; 4 each of oats, apples, tomatoes and forage crops; 3 each of small fruits, early potatoes and cranberries, etc. One hundred and eight of the 162 correspondents gave potatoes as among the least profitable crops; 28, corn; 23, apples; 8, cabbage; 7 each of squash and peas; 4, tomatoes; 3, oats, etc. In conclusion, it is thought that, for the State as a whole, farmers probably no more than held their own during the season of 1897.

Massachusetts Weather, 1897.

[Compiled from data furnished by the Weather Bureau, Boston.]

January averaged warmer than usual, except along the south-eastern coast, where slight deficiencies in temperature occurred. A warm spell prevailed from the 3d to 5th inclusive, with the maxima ranging in the fifties. Winter temperatures were then the rule until the middle of the month. A most pronounced cold wave set in on the 19th. This produced remarkable temperature falls, averaging 40° to 60°. By the 21st the weather was again moderate, and so continued. The storm of the 5th gave general heavy rains; that of the 17th and 18th was also mostly rain. The storm of the 20th and 21st began as snow, but changed to rain. There was little snow during the month until the great storm of the 28th. This was a typical coast storm. From 12 to 18 inches of snow fell, and the month closed with a large body on the ground.

February was an agreeable change from the severe weather conditions which generally characterize the month. Heavy storms were not numerous. There were only two pronounced cold waves. Zero weather was almost steady

throughout the first six mornings in all but coast sections. During the second decade and the greater part of the third the mercury went below zero but few times, although the closing days brought a cold spell. There were numerous mild, spring-like days, and the general conditions presented a marked contrast to those of the same month in 1896. The precipitation averaged a departure below the normal of 0.95 inch. A good snow covering protected the ground. The snowfall averaged 13 inches.

March was a stormy, disagreeable month, although it is true that there was no great storm. In the first half of the month there was precipitation on nine days, but the storms were moderate. Fair weather prevailed from the 15th to the 18th, followed by the second storm period, which lasted until the 27th, with heavy rains on the 24th. The closing days were fair and remarkably pleasant. The precipitation was but slightly below normal. The average snowfall was but 4 inches. At the end of the month, the ground was bare and rivers and ponds were in general free from ice. The month opened with a temperature ranging nearly as low as on any day of the winter. Low morning temperatures continued through the first ten days, and another cold period prevailed from the 13th to 18th. From the 18th to the close of the month the weather was almost uniformly mild.

The monthly mean temperature for April was above the normal by 2.3°. The highest temperatures were mainly recorded on the 25th, and were above 80°, as a rule. The feature of the month with regard to this element was the sudden and most decided fall on the 20th, amounting almost to a cold wave. South-westerly winds on the 19th made that a mild day, but all the time a large body of cold air was proceeding eastward from the lake regions, following closely in the rear of a storm which was moving down the St. Lawrence valley. By the morning of the 20th the fall in temperature amounted to from 40° to 50°, and the mercury registered below freezing all over the State. The cold was all the more bitter for being so unseasonable. No particular damage was caused by this freeze.

The temperature of May ranged below the normal during the first eight days, averaging a deficiency of about 2.5°

each day. During this period the nights were altogether too cold for rapid or even steady growth. It was very cool on the morning of the 8th, and in western Massachusetts ice formed and the ground froze in low lands, but a high wind protected fruit. Farm work was nearly at a standstill from the 10th to the 17th, owing to the prevalence of general heavy rains. Copious rains fell on the 12th and 13th, amounting in central sections to about two inches. The temporary delay in planting caused by the wet weather was more than compensated for by the immense good done to all vegetation. Grass, especially, pushed forward wonderfully fast. The week ending the 24th was cool and very dry, with considerable high wind. In the central and western portions of the State the rainfall was little more than a trace. There was an abundance of sunshine, but the cool nights checked growth. Frosts on the 22d and 23d produced no great damage. Heavy thunder-showers during nights of 24th and 25th.

The month of June opened unfavorably for the farmer. During the week ending on the 7th, the weather was too cool and wet for a good growth of any crop. There was very little sunshine. The temperature ranged about normal throughout the first four days, although on several mornings the mercury registered below 50°, and there was a narrow escape from frost in low places on the 2d. Frequent rains, accompanied by hail and high winds in some localities, occurred, although, as a rule, the precipitation was not heavy.

The week ending with the 14th brought no improvement in the general conditions, but, on the contrary, the situation was nearly at the worst. Only one clear day occurred during this period, and with the cool temperature and the rain all crops were greatly retarded. An exceptionally heavy rainfall came on the 9th and 10th. The temperature averaged a daily departure below the normal of 8°, and by the 14th it was more than 100° deficient for the month, while the precipitation was greatly in excess of the usual amount. The week ending with the 21st was the most favorable of the season up to that time; still, the lack of sunshine was a detrimental factor. Several days were favorable for haying. The temperature averaged about normal, and the rainfall con-

sisted of light showers on three days. The mornings of the 17th and 19th were especially cool, the temperature falling below 50° in all but coast sections.

A very satisfactory week was that which ended with the 28th. The rainfall was very light, and much sunshine predominated. A warm spell set in, commencing with the 22d, when the temperature rose to 80°, and terminated on the 25th with maximum of over 85°.

July was characterized by meteorological features which will cause it to be long remembered. The excessive heat during the first decade, the abnormally heavy rains of the 13th and 14th, unequalled for many years, the occurrence of severe local storms, and the spell of gloomy and unseasonably cool weather at the close of the month constituted a chain of conditions which illustrate the variability of New England climate.

The month began with temperature at the seasonal average. A heated spell set in on the 5th and continued without interruption until the 10th. During this period maximum temperatures of 90° and over were commonly registered, and under the influence of the intense heat and bright sunshine, with but little rainfall, all crops advanced rapidly and healthfully. The warm spell was terminated, temporarily, on the 10th, by a so-called "sea-turn" on the coast, and which was generally felt throughout the State. From the 12th to the 25th there was the usual number of days of summer warmth, but no extreme heat, although many days were extremely trying, owing to moist, south winds. A season of damp, east winds, beginning with the 25th and lasting through the 29th, gave very cool temperatures, averaging a daily departure below the normal of 8°.

The precipitation record was a remarkable one, and easily takes front rank as the most important characteristic of the month. The first five days witnessed but little rainfall, generally speaking, except that on the 2d a heavy local storm, accompanied by hail, visited portions of Worcester County. Heavy thunder-showers traversed the western part of the State on the 7th, washing roads and beating down crops, but on the whole the rain was a benefit. From that date up to the time of the great storm of the 13th–14th, generally fair

weather prevailed. The last-named storm was of an exceptionally violent character, in fact, almost unprecedented at this season of year. It came from the western States, moved across the lake regions on the 12th, and became central in western Massachusetts on the morning of the 13th. Its centre remained nearly stationary through the 13th and 14th, owing to the obstructing area of high barometer in the north-east, and during these two days torrents of water were poured over all the State except the extreme eastern and south-eastern parts. The actual precipitation in interior and western Massachusetts was from 5 to 8 inches. The gale which attended the storm was of great violence. The wind attained a velocity of fifty miles at Boston on the morning of the 14th, and for one minute it blew at the rate of sixty miles per hour.

The week ending with the 26th was damp and unsettled, with hardly a single fine, clear day. Meadows and lowlands continued too wet for cultivation, and much mown hay was caught by rains and spoiled. Heavy thunder-storms passed across the State on the 23d and 24th, damaging crops to some extent. At Fitchburg more than three inches of rain fell in a thunder-storm, and a general rain storm on the 22d gave large amounts of water. The month was brought to a close with heavy rains on the 29th, when a coast storm was central off Nantucket.

It will be necessary to scan the records for many years back to find a parallel July, especially with reference to precipitation.

In its chief meteorological features the month of August was nearly normal, and it passed without many specially noteworthy phenomena of any kind. There were several days of unseasonably cool weather, and on the 21st the escape from light frosts in the interior sections was by a narrow margin. There was a remarkable paucity of so-called "dog-days," which was one of the agreeable features. Although there were some heavy rains, mostly local in character and occurring during thunder-storms, very little damage was sustained anywhere. In the eastern part of the State rain fell on an average of ten days, while in central and western portions the average was slightly greater.

Thunder-storms were frequent, but not more so than naturally to be expected at this season.

The first week gave warm and good growing weather, with less rain and abundant sunshine. The fair days greatly outnumbered the foul.

The second week was rather more unfavorable in all but the eastern and south-eastern counties. In the interior and the western counties showers were quite numerous. There were only three days that brought even one-fourth of the usual amount of sunshine. In the eastern districts, the week, generally speaking, was favorable, as the precipitation was very small.

The third week opened with thunder-storm conditions. The storms on the 15th were apparently the most general, and in certain localities they assumed violent proportions. The 18th again saw electrical disturbances in various parts of the State. In fact, the week brought overmuch rain, and the continued wet weather proved a serious drawback to farming operations. The night temperatures were low and unseasonable, falling below 50° on several occasions.

The week beginning with the 22d again witnessed thunder-storm conditions in the ascendency, and the storms which occurred on this date kept good the character of the summer for unusual doings. The first steady and general rainstorm of the month was on the 24th, occasioned by a storm which moved up the Atlantic coast and centred off our southern coast on the morning of that day. It gave a large rainfall at Boston, in the course of which more than one-half inch fell in twenty minutes. The 23d and 24th were days of cool temperatures, but the remainder of the week was warm and seasonable, with very pleasant skies.

Probably the most important characteristic of the month of September was the hot wave which set in on the 9th and lasted through the 11th, with maximum temperatures ranging in the 90's. The warmest day was the 10th, when the mercury rose as high as on any day during the summer, and, in fact, the heat was terrific, but fortunately it was not accompanied by excessive humidity. It is commonly supposed that these September hot waves are a development of recent years, but the records of the Weather Bureau indicate

that this month has nearly always produced its quota of warm weather, and the highest temperature recorded at Boston in the history of this Bureau occurred on a September day, — the memorable "yellow day" of 1881, the 7th, when the mercury rose to 102°. Following the culmination of this September's hot wave, the temperature fell decidedly, and on no day throughout the remainder of the month did it rise beyond seasonable figures. On the other hand, beginning with the 15th, the nights became quite cool, the mercury often falling below 50. The first general frosts were on the morning of the 22d. In many localities the frost was destructive, notably on the lowlands of the interior, but in the eastern part of the State the damage was slight. Light frosts were again general on the morning of the 28th. These dates are believed to be about the average.

The storm periods were few, and there were no particularly large rainfalls. The average number of days with an appreciable amount of precipitation was less than ten. The first decided storm of the month was that which commenced on the evening of the 23d and ended before noon of the 24th. The bright and sunny days greatly outnumbered the cloudy days, and the storms were of slight intensity as a rule. Rain was needed to settle dusty roads, but there was no lack of water otherwise, owing to the excessive rains of the preceding months.

October was characterized by weather conditions which, in the main, were of the best. The temperature was unusually mild and the precipitation very deficient. At many places the total monthly rainfall was less than one-half inch. The total of rainy days which would interfere with out-door work was but one, and the entire number of days with an appreciable amount of rain averaged not more than three for the entire State.

The month came in with conditions strongly suggestive of a return to summer. On the 1st the temperature rose above 85° in numerous localities, but late in the afternoon it began to fall, and on the 2d its range was 30° or 40° lower. On the 7th the mercury sought a lower range, and the cool wave culminated on the morning of the 10th, with the temperature varying from 25° in western and interior sections to slightly

below 40° on the coast. The most marked feature of the month was the wave of summer heat which prevailed throughout the 15th and 16th. The 15th was, in every respect a perfect summer day, and the heat was prolonged through the 16th, reaching almost 90° on the latter date. The highest October temperature on record at the Boston Weather Bureau office was 90° on the 1st, in 1881, and this record was very nearly equalled by the temperature of the 16th of this October. The hot spell was brought to a close early Sunday morning, the 17th, when the arrival of a cold north-west wind forced the mercury rapidly downward. At 8 A.M. of the 17th, the thermometer stood some 30° or 40° lower than twelve hours previous, — a striking evidence of the versatility which enables our New England climate to go at one jump from midsummer temperature to autumnal chill. Low morning temperatures were the rule onward to the close of the month, and after the 19th the day temperatures ranged below 60°.

The coast sections were visited on the 21st by a tropical hurricane.

While the weather of November presented no especially unusual features, it was on the whole quite unpleasant. The large number of days with precipitation and the consequent excessive cloudiness contributed in a great measure to the generally disagreeable conditions. The days with a measureable amount of rain or snow averaged 14, and the precipitation was in the main evenly distributed throughout the State, and was above the average by about two and one-half inches. The month opened with a heavy rainstorm, which gave excessive amounts in some localities, and not less than two inches in any part of the State.

The first snowfall of consequence occurred in the early morning of the 12th, and a large part of the precipitation thereafter was in this form. The average date of the first snowfall of the season is November 15. The temperature was greatly in contrast with that of the corresponding month of 1896, which, it will be remembered was remarkably mild. The month was not without several warm days, however, notably in the first decade, also the 16th, 21st, 26th and 27th. The minimum temperatures were almost invariably

recorded on the 24th, and were very near the zero point in the interior. The rapid rise in temperature from the 24th to the 26th deserves mention, the recovery within that period being from 50 to 60 degrees.

The atmospheric pressure fluctuated rapidly, some decided changes were noted in comparatively short periods, and the wind movement was characterized by frequent violent gales, particularly in the early part of the month.

Although rather given to stormy conditions, portions of December were mild and pleasant. The month opened somewhat cold, with a moderate snowfall. The cold increased during the few succeeding days, but on the 5th the temperature recovered from 40 to 50 degrees, followed by a slight cold wave on the 7th. Mild weather was the ruling feature from the 10th to the 18th. At Boston the maximum temperature of 64° on the 10th has been exceeded in this month but twice since 1872. Early on the 18th the temperature began to seek a lower level, and Sunday morning, the 19th, found the mercury at a low figure, with the atmosphere rendered more biting by thrashing north-west gales. The period of cold weather thus instituted was carried on almost without interruption until near the close of the month. The coldest days were the 25th and 29th.

The principal storms were on the 5th, 14th-15th, and that which commenced on the afternoon of the last day. The heaviest storm, in respect to amount of precipitation, was that of the 14th–15th. The precipitation, almost wholly in the form of rain, averaged from two to four inches. This heavy rainfall brought on a freshet in the Connecticut River valley, so that the stage of the water was but little lower than that of the extraordinary July floods, while small streams overflowed banks and flooded meadows. The snowfall of the month was large in western sections, and merely nominal in central and eastern. The open weather in the middle of the month permitted ploughing to be done for several days.

Meteorological Observatory of the Hatch Experiment Station (Massachusetts Agricultural College), Amherst.

Annual Summary for 1897.

Pressure (in Inches).

Maximum reduced to freezing, 30.54, March 1, 7 A.M.
Minimum reduced to freezing, 28.82, Nov. 9, 7. P.M.
Maximum reduced to freezing and sea level, 30.88, March 1, 7 A.M.
Minimum reduced to freezing and sea level, 29.12, Nov. 9, 7 P.M.
Mean reduced to freezing and sea level, 30.014.
Annual range, 1.76.

*Air Temperature (in Degrees F.).**

Highest, 91.5, Sept. 10.
Lowest, —11, Feb. 1.
Mean, 46.5.
Mean of means of max. and min., 46.8.
Mean sensible (wet bulb), 43.7.
Annual range, 102.5.
Highest mean daily, 78.1, July 9.
Lowest mean daily, 5.0, Jan. 19.
Mean maximum, 57.1.
Mean minimum, 36.5.
Mean daily range, 20.6.
Greatest daily range, 47.0, Oct. 4.
Least daily range, 3.5, Nov. 19.

Humidity.

Mean dew point, 39.6.
Mean force of vapor, .402.
Mean relative humidity, 76.4.

Wind.—Prevailing Direction, West, or S. 79° W. Summary (Per Cent).

South, 19.
North-west, 12.
West, 11.
North, 10.
South-south-west, 8.
West-north-west, 8.
North-north-west, 7.
South-west, 7.
Other directions, 18.
Total movement, 54,220 miles.
Greatest daily movement, 400 m., Jan. 26, Feb. 2.
Least daily movement, 11 m., Feb. 1.
Mean daily movement, 146.8 miles.
Mean hourly velocity, 6.1 miles.
Maximum pressure per square foot, 22 pounds = 66 miles per hour on May 10, 2 P.M., W. S. W.

Precipitation (in Inches).

Total precipitation, rain or melted snow, 57.05.
Number of days on which .01 or more rain or melted snow fell, 127.
Snow total in inches, 52.8.

Weather.

Mean cloudiness observed, 51.4 per cent.
Total cloudiness recorded by sun thermometer, 2209 hours = 50.5 per cent.
Number of clear days, 108.
Number of fair days, 109.
Number of cloudy days, 148.

Bright Sunshine.

Number of hours recorded, 2325 hours = 50.1 per cent.

Dates of Frosts.

Last, May 8.
First, Sept. 22.

Dates of Snow.

Last, April 27.
First, Nov. 12.
Total days of sleighing, 38.

Gales of 50 or More Miles per Hour.

Jan. 18, 61 m., W.; Jan. 23, 55 m., W. N. W.; Jan. 25, 52 m., W. N. W.: Jan. 26, 55 m., N. N. W.; March 4, 51 m., N. W.; March 13, 51 m., W. N. W.; March 15, 52 m., W. N. W.; April 19, 58 m., N. W.; May 10, 66 m., W. S. W.; Aug. 15, 53 m., S. S. W.; Sept. 26, 64 m., N. W.; Nov. 9, 63 m., W.

J. E. OSTRANDER, *Meteorologist.*
A. C. MONAHAN, *Observer.*

* Temperature in ground shelter.

Massachusetts Crop Reports.

Monthly crop bulletins or reports were published as in previous years, and six in all were issued (May–October), aggregating 222 pages of printed matter. Twenty-four hundred copies of No. 6 and 2,500 copies of Nos. 1, 2, 3, 4 and 5 were printed and distributed.

The special subjects treated were: Bulletin No. 1, "Small fruits in the home garden;" Bulletin No. 2, "Three shade-tree insects;" Bulletin No. 3, "Why milk sours, and how the souring can be prevented or at least delayed;" Bulletin No. 4, "Systematic feeding and watering as a preventative of disease in horses;" and Bulletin No. 5, "Massachusetts weeds." These special articles will be found printed on pages 225–277 of this volume.

Publications.

This office issued the following publications during the calendar year 1897: —

	Pages.	Number.	Date of Issue.
Catalogue of Abandoned or Partially Abandoned Farms, sixth edition.	80	2,000	January 27.
Agriculture of Massachusetts, 1896, .	879 *	15,000	April 16.
Crop Bulletin, No. 1, May, ...	40	2,500	June 1.
Crop Bulletin, No. 2, June, ...	37	2,500	July 1.
Crop Bulletin, No. 3, July, ...	39	2,500	August 2.
Crop Bulletin, No. 4, August, . . .	39	2,500	September 1.
Crop Bulletin, No. 5, September, .	35	2,500	October 2.
Crop Bulletin, No. 6, October, . . .	32	2,400	November 4.
Regulations of Board, speakers and subjects, farmers' institutes.	12	600	November 22.
Catalogue of Abandoned or Partially Abandoned Farms, seventh edition.	84	1,500	December 23.

* Including ninth annual report of the Hatch Experiment Station, 254 pages.

Legislative Appropriations for Agricultural Purposes.

Objects for which appropriated.	1895. Appropriated.	1895. Used.	1896. Appropriated.	1896. Used.	1897. Appropriated.	1897. Used.	1898. Appropriated.
Bounties to societies,	$21,000 00	$20,606 20	$21,000 00	$20,084 12	$21,000 00	$20,344 68	$21,000 00
Travelling and necessary expenses of the Board,	1,900 00	1,509 93	1,900 00	1,600 03	1,900 00	1,527 92	1,900 00
Travelling and necessary expenses of the secretary,	500 00	481 40	500 00	492 42	500 00	500 00	500 00
Incidentals in office of secretary,	700 00	700 00	800 00	800 00	800 00	800 00	800 00
Salaries of secretary and clerks,	5,300 00	5,300 00	5,300 00	5,300 00	5,300 00	5,300 00	5,300 00
Dissemination of useful information in agriculture by means of lectures or otherwise,	2,650 00	2,650 00	2,800 00	2,800 00	2,800 00	2,800 00	2,800 00
Printing 15,000 copies of the "Agriculture of Massachusetts,"	5,836 33	5,836 33	5,473 86	5,473 86	6,100 13	6,000 13	*5,900 00
Collecting and circulating information relative to abandoned farms,	-	-	1,000 00	283 00	†727 00	419 54	-
Carrying forward work of Dairy Bureau,	7,000 00	6,477 68	7,000 00	6,998 95	7,000 00	7,000 00	7,000 00
Salary of executive officer of Dairy Bureau,	500 00	500 00	500 00	500 00	500 00	500 00	500 00
Salary of assistant in work of Dairy Bureau,	1,200 00	1,200 00	1,200 00	1,200 00	1,200 00	1,200 00	1,200 00
Nails or spikes for marking shade trees for preservation,	200 00	199 34	200 00	133 34	200 00	47 17	200 00
Aggregates,	$46,786 33	$45,460 88	$47,673 86	$45,665 72	$48,027 13	$46,439 44	$47,100 00

* Estimated. † Unexpended balance.

Also the Legislature of 1897 made the following regular annual appropriations: for maintaining an agricultural experiment station at the Massachusetts Agricultural College, $10,000; for the said college, for free scholarships, $10,000; for the said college, for labor fund and extra instruction, $10,000; for travelling and other necessary expenses of the trustees of the said college, $800; and to defray expenses of collecting and analyzing samples of concentrated commercial feed stuffs, $1,200. The Legislature also appropriated $150,000 for carrying forward the work of extermination of the gypsy moth, and $12,000 for repairs and improvements at the Agricultural College. The appropriations thus listed amount to the sum of $242,027.13.

Legislation.

The legislation of 1897 having reference to the Board of Agriculture or to the agricultural societies was "An act making appropriations for sundry agricultural expenses" (Acts of 1897, chapter 59); "An act making an appropriation for continuing the work of extermination of the gypsy moth" (Acts of 1897, chapter 107); "An act to require local authorities to suppress the brown-tail moth" (Acts of 1897, chapter 516); "A resolve to provide for printing the special report of the Board of Agriculture on the extermination of the gypsy moth" (Resolves of 1897, chapter 20).

Also, through the efforts of the State Board of Agriculture and others interested, the Legislature of 1897 passed an act "relative to concentrated commercial feed stuffs." * This act placed the work in the hands of the director of the Hatch Experiment Station of the Massachusetts Agricultural College, and appropriated the sum of twelve hundred dollars annually to defray the expenses of collecting and analyzing the samples and of publishing the results. It is understood that since October last the station has had a man cover the entire State, and some three hundred samples have been taken, which are now being examined. It is intended to publish the results in a bulletin within a very short time. It is also intended to make another collection in March, and also a special collection very soon for cotton-seed meal.

* See chapter 117, Acts of 1897.

Spikes and Washers.

The appropriation for the purchase of M spikes and washers was the usual $200, and there was expended during the year the following sums: —

1,059 pounds M spikes, $2\frac{1}{4}$, $2\frac{3}{4}$, $3\frac{1}{4}$ inches,	$41 79
One M stamp,	5 00
Cartage,	38
Total,	$47 17

Spikes and washers were supplied during the year to the towns of Athol, Boxford, Gardner, Hubbardston, Hudson, Littleton, Lynnfield, North Andover, North Attleborough, Northborough, Northfield, Oakham, Oxford, Royalston, Sandwich, Sutton, Ware and Wilbraham, an increase of twelve towns over the number supplied in 1896. Since the work of supplying these spikes was begun, Dec. 26, 1891, three cities and sixty-six towns have availed themselves of the provisions of the act. In all there have been furnished approximately 155,000 M spikes during the period named.

Scales of Points.

As in past years, scales of points or score cards have been supplied when called for. Quite a quantity of the cards still remain in the office of the secretary, subject to call.

Abandoned Farms.

Because the supply of copies of the sixth edition of the catalogue of abandoned and partially abandoned farms issued Jan. 27, 1897, was nearing exhaustion, and because the balance of the appropriation of $1,000 made by the Legislature of 1896 was sufficient to pay the expense, it was decided, in October last, to issue another edition of the catalogue. Therefore a return postal card was prepared and mailed to each person having a description of a farm in the sixth edition of the catalogue, in order to ascertain what disposition, if any, had been made of the property.

Replies were received concerning 188 of the 236 farms described in the sixth edition. Of these replies, 27 were

notices of sales, 9 of withdrawals and 152 of a desire to have description continued.

Fourteen of the 27 farms reported sold in 1897 were sold for farming purposes, 2 for a home, 2 for poultry, and 1 each for pasture, for stock and poultry, for summer residence and for wood and timber.

Of these purchasers of farms in 1897, 15 were residents of Massachusetts at time of purchase, 3 of New York, and 1 each of Vermont, New Jersey, Ohio and Florida.

The act authorizing the State Board of Agriculture to collect and circulate information relating to abandoned or partially abandoned farms was approved May 4, 1891.

A summary of the work done to date is herewith presented: —

Number of farms reported by assessors,	1,187
Number of farms reported by individuals,	748
Total number of farms reported,	1,935
Number of farms in State, census of 1885,	45,010
Number of owners or agents making reply to request for description,	914
Number reporting an intention to keep property,	164
Number reporting property already disposed of,	59
Number reporting informant to have been misinformed,	53
Descriptions of farms received,	638
Circular letters to owners returned by post-office department as unclaimed,	100
Catalogued farms reported sold,	269
Catalogued farms withdrawn at request of owners,	104

In regard to residence of the 269 purchasers, the following is shown: Massachusetts, 159; New York, 14; Connecticut, 10; New Hampshire, 5; Vermont, Rhode Island, Ohio and Florida, 3 each; New Jersey, 2; Nova Scotia, Maine, Indiana, Illinois and Wisconsin, 1 each; not reported, 62.

In regard to the use which the purchasers intended to make of the farms purchased, the returns showed the following: for general farming, 108; for a home, 25; for an investment, 13; for a summer residence, 13; for poultry, 7; for poultry and farming, 7; for dairying, 7; for the wood and lumber, 7; for sheep raising, 3; for stock and poultry, for cranberry growing, for fruit and poultry, for

poultry and market gardening, and to cut into small lots for emigrants, 1 each. No statement was received concerning 74 of the farms reported sold.

The appropriations for carrying on this work have been as follows: 1891, $2,000; 1893, $1,000; 1896, $1,000; total, $4,000. However, of this amount, $1,230.95 reverted back to the State treasury as unused, as it was not found expedient to use it before the two-year limit had expired.

The expenditure of the $2,769.05 thus actually available is shown by the following summary: —

Printing 15,000 catalogues, 7 editions, 1 supplement, . .	$1,750 39
Postage stamps for mailing catalogues and circulars, . .	560 00
Services members of the Board of Agriculture in getting names and addresses of owners, ...	196 30
Special envelopes for mailing catalogues, ...	162 32
Printed circulars, ...	94 54
Advertising, ...	3 50
Express, ...	2 00
	$2,769 05

Farmers' Institutes.

The 35 societies represented on the Board of Agriculture held 125 farmers' institutes during the calendar year 1897. Lecturers were furnished by this office for 97 institutes, at a total cost of $1,479.08 for services and expenses,—an average of $15.25 per institute. All of the societies but the Massachusetts Society for Promoting Agriculture, which holds no institutes, held the required 3, and 8 held 4 or more. For certain reasons it seemed wise during the year to arrange institute meetings not directly under the control of the incorporated societies. Three such meetings were held, and the lecturers were furnished through this office, at an expense of $41.67, or $13.89 per meeting, — making the cost of the one hundred institutes $1,520.75. As in past years, a pamphlet has been issued by this office, containing the regulations of the Board of Agriculture concerning the holding of farmers institutes, with a list of available lecturers and their subjects. It is hoped this pamphlet will be useful to officers of societies and institute committees during the season of 1897–98.

Dairy Bureau.

On account of the expiration of his term of service on the Board of Agriculture, Mr. Geo. L. Clemence, one of the original members of the Bureau, has been retired, and Mr. C. D. Richardson of West Brookfield has been appointed by His Excellency to fill the vacancy thus caused in the Bureau.

The seventh annual report of the Bureau to the Legislature will be found printed on pages 281–303 of this volume.

Gypsy Moth (*Ocneria dispar*).

The sum of $150,000 was appropriated by the Legislature of 1897 for the continuation of the work of exterminating this pest. The annual report of the committee in charge, with appendix, will be found printed on pages 307–439 of this volume. At the annual meeting of the Board, Jan. 12, 1898, the committee of 1897 was re-elected, to have charge of the work in 1898, with the exception that Mr. N. I. Bowditch of Framingham was elected in place of Mr. J. G. Avery, whose term of service on the Board had expired.

San José Scale.

The ravages of injurious insects are an important factor in the business of agriculture, and the number of kinds with which our farmers and fruit growers have to contend is being rapidly increased by the introduction of new species from foreign countries. Among them are the San José scale. The scale has been detected in a few nurseries in the State by the agents of the Hatch Experiment Station. I am happy to be able to state that in every case the owners of such nurseries have taken suitable measures to rid their premises of the pest. The scale has also been found on fruit trees in private grounds in several localities in the eastern part of the State, in which case treatment was advised. As an illustration of what may be accomplished, I give an account of experience with an orchard of young apple trees in Scituate, owned by Mr. E. E. Cole. The orchard was inspected on March 2, 1897. Of 106 trees in the orchard, 59 were found considerably infested, 12 of

them so badly that Mr. Cole was advised to burn them, which he did. The remainder were thoroughly treated with whale-oil soap and water, one and a quarter pounds of soap to one gallon of water. The weather at the time of treatment was so cold that the ordinary formula, two pounds of soap to one gallon of water, could not be used. On Aug. 27, 1897, a careful examination of the orchard, at which time I was present, did not reveal more than a half-dozen living scales. The owner was advised to repeat the treatment as soon as the leaves fell. This remedial treatment should only be used when the trees are bare of foliage. It is probably the cheapest and best means yet discovered for holding the San José scale in check.

Imported Insects.

The Board of Agriculture has received notice, through the Entomological Division of the United States Department of Agriculture, of the importation into Massachusetts of several invoices of shrubs and plants from Japan, with the request that the consignees be notified that there is danger of the introduction of new insect pests on such plants and shrubs. In each case the parties receiving such goods have been notified, and requested to have the importation carefully examined and treated in such a manner as to destroy any eggs or insect that may possibly be present. As this State has no legislation restricting importation or providing for inspection of imported plants and shrubs, nothing more could be done. It may not be out of place to state that the State of California has laws that provide for the official inspection of all trees, shrubs and plants brought into the State from foreign countries, or from other States of the Union. The law also empowers the proper officer to apply, at the expense of the owner, proper remedial treatment to such incoming trees, etc., or, if in his judgment it is necessary, to cause them to be destroyed.

A national convention of delegates from horticultural societies, nurserymen's associations, boards of agriculture, granges and agricultural colleges was held at Washington, D. C., on March 5 and 6, 1897. This convention unanimously recommended that the United States Congress pro-

vide for inspection and treatment by national authority of all trees, shrubs and plants imported into the country, and also of all such articles transported from one State to another. The danger is sufficiently great to warrant such action, and it is hoped that the present congress may enact the necessary legislation.

Brown-tail Moth.

An example of accidental importation of a new and dangerous insect pest may be seen in the case of the brown-tail moth, brought to public notice during the past season in Somerville. This new pest was undoubtedly brought from Europe on imported shrubs.

The last Legislature passed a law requiring officers of municipalities and owners and managers of estates found infested with the brown-tail moth to take immediate steps for its extinction and to prevent its spread. The law also makes it the duty of the Board of Agriculture "to cause inspections to be made upon the receipt of notice from local authorities, and also whenever the Board has reason to suspect the presence of this pest in any city or town, and to furnish the local authorities an ample supply of printed directions as to the best methods for its confinement and extinction."

No appropriation was made from which to defray the expense of performing the duties imposed. In the emergency the Hatch Experiment Station issued a bulletin of information on the new pest, which contained directions for destroying it, and, on payment of one hundred dollars from our appropriation for dissemination of useful information in agriculture, furnished a supply to be used as "printed directions." In the attempt to fulfil the duty of "inspection" placed upon the Board of Agriculture by the law, the lack of money to pay the bills has prevented a complete compliance with the requirements; but, on the advice of the Attorney-General, as much work in this direction as was possible under the circumstances has been done. As the habits of the insect were learned, it was found that reliable inspection at the minimum cost could not be accomplished until the leaves had fallen. The young caterpillars pass the winter in small tents or nests, which are constructed near the tips of the branches

of infested trees. One or more leaves are surrounded with a silken web, which draws the leaves together, forming a nest. The nests are readily seen during the late autumn and winter, and should be taken off and burned. As large a sum as could possibly be spared from the appropriation for incidental expenses of the Board of Agriculture was used in paying a competent inspector to examine the infested territory, and give written notice to owners or managers of infested estates that the brown-tail moth was present on the premises. At the same time a copy of the before-mentioned bulletin, which contained a copy of the law, was left with the owner or manager. One hundred and seventy-two dollars and sixty-six cents was expended in this manner, in addition to the one hundred dollars paid for bulletins noted above. Fourteen hundred and eleven estates in Somerville, 355 in Cambridge, 149 in Medford, 92 in Malden, 72 in Everett, 31 in Melrose, 31 in Stoneham, 29 in Arlington, 21 in Winchester, 19 in Woburn, 7 in Charlestown, 3 in Belmont, 3 in Burlington, 2 in Saugus and 1 in Revere, were found infested, and notice given and printed directions left with the owners or managers of these estates.

This inspection is far from complete in all of these municipalities, but has covered as large a part of the infested territory as the means at command would pay for. The authorities of all these municipalities have been notified of the presence of the moth, and a list of the estates found infested in their city or town furnished them, with the statement that the inspection was necessarily incomplete, and that many other estates as well as street and park trees and shrubbery are undoubtedly infested. Some of the owners of estates have made commendable effort to rid their property of the pest, while others have done nothing. I have been informed that the authorities of the cities of Cambridge, Everett, Malden and Somerville are making plans to perform the duties placed upon them by the law of last winter. It is hoped that the other cities and towns may do likewise.

It will be impossible for the Board of Agriculture to fulfil its duties under the law in future unless the Legislature provides the means. Steps have been taken to bring the matter to the attention of the proper committee of the Legislature.

Before leaving this subject, it may be well to say that the brown-tail moth has by this inspection been found in a much larger extent of territory than was expected. When the creature was last summer identified as a new imported pest, it was observed in large numbers in Somerville and Cambridge, and a few were noticed in those parts of Medford, Malden and Everett nearest to the infested parts of Somerville and Cambridge. The action of the Legislature was taken at so late a date that it was impossible to procure action by municipal authorities or private individuals before the caterpillars had changed to the moth stage. The female moth of this species, unlike those of the gypsy moth, moves easily on the wing, and the air about the infested locality at night was filled with immense numbers of the flying creatures. Just at the time when they were most plentiful, July 13 and 14, a violent gale of wind from the south prevailed, which it is believed scattered them through the cities and towns above enumerated as infested. As a consequence, the territory now infested is many times larger than was the case at the time the fact of their presence was first noticed.

This creature seems certain to prove a great pest, as it is not only very destructive to all fruit trees and many shade and forest trees, but is also very annoying to people, by reason of the painful irritation caused by the caterpillars when coming in contact with the skin. In some instances much suffering has been caused to individuals in this way, and the services of a physician have been required in treating the patients.

The plan of requiring municipalities and property owners to destroy the pest is now on trial, and it is hoped that this plan may be given a thorough test, and that it may not fail through a lack of interest of officials and individuals. It is very important that all our people in all parts of the State should be on the lookout for evidences of the insect, and, when it is found, the remedies recommended in the bulletin should be thoroughly applied.

Agricultural College.

The report of the examining committee of the Agricultural College will be found printed on pages 184–192 of this

volume. The tenth annual report of the Hatch Experiment Station of the college is by law bound with the report of the secretary of the Board of Agriculture in this volume.

Returns of Societies.

These returns will be found printed on pages 601–630 of this volume. A summary, contrasting the totals of 1895, 1896 and 1897, is printed on page 630 of this volume.

Agricultural Directory.

A directory of the agricultural organizations of the Commonwealth, with officers for 1898, will be found printed on pages 633–646 of this volume.

Meetings of the Board.

The public winter meeting of the Board for lectures and discussions was held at Taunton, Dec. 7, 8 and 9, 1897. The lectures and discussions will be found printed on pages 17–169 of this volume. A special business meeting of the Board was held at Taunton, Dec. 7, 1897, an account of which will be found printed on pages 11–14. The annual business meeting of the Board was held at the office of the secretary, Jan. 11 and 12, 1898, and the minutes thereof, etc., will be found printed on pages 173–222 of this volume.

Changes in the Board.

During the past year death removed from the Board Atkinson C. Varnum, Esq., of Lowell, who had represented the Middlesex North Agricultural Society on the Board since February, 1880. Mr. Francis Shaw of Wayland, who had represented the Massachusetts Society for Promoting Agriculture on the Board since February, 1895, resigned from the Board during the year, as did also Mr. Charles E. Seagrave of Uxbridge, who had represented the Blackstone Valley Agricultural Society on the Board since January, 1897. The following gentlemen retired from the Board at the recent annual meeting because of the expiration of their term of service: Wm. P. Brooks of the Hampshire Agricultural Society, after three years of service; H. G. Norton of the Martha's Vineyard Agricultural Society, after four

years of service; W. M. Wellington of the Oxford Agricultural Society, after three years of service; John G. Avery of the Spencer Farmers' and Mechanics' Association, after three years of service; Curtis M. Blair of the Union Agricultural and Horticultural Society, after three years of service; and George L. Clemence of the Worcester South Agricultural Society, after nine years of service.

Cattle Commission.

The report of the Board of Cattle Commissioners (Pub. Doc., No. 51) is by law printed in the annual report of the State Board of Agriculture, and the report for 1897 will be found printed on pages 443–581 of this volume.

Farmers' National Congress.

The report of the delegates to the Farmers' National Congress at St. Paul, Minn., Aug. 31 and Sept. 1, 2 and 6, 1897, is by request included in this volume, and will be found printed on pages 585–598.

Work of the Board.

The work of the Massachusetts State Board of Agriculture during the last ten years has been greatly extended both by duties imposed by legislation and by the voluntary increase of effort for the benefit of Massachusetts agriculture. Among the duties imposed by legislation is that by the law of 1890, providing that no agricultural society which receives State bounty shall mortgage or sell its real estate until its vote to mortgage or sell has been approved by the Board of Agriculture. As this Board has but two regular meetings annually, and as applications for the necessary approval of votes to mortgage or sell grow more and more frequent, its executive committee is often obliged to hold special meetings for this business.

The act of 1891, authorizing the Board to collect and circulate information relating to abandoned farms, and which still continues in force, has largely increased the work in the office.

In 1891 a resolve was passed instructing the Board to investigate and ascertain the best methods to protect citizens

of the Commonwealth against the dangers from tuberculosis in the food products of cattle; but the Board was soon relieved of this work by its being placed upon the Board of Cattle Commissioners.

The same year the duty of furnishing nails or spikes upon application of city and town authorities, to be used in marking shade trees, was placed upon the secretary of this Board.

In the same year the Legislature created the Dairy Bureau of the Board of Agriculture, making the secretary its executive officer, and making it the duty of this Bureau, under the direction of the Board of Agriculture, to enforce all laws relating to dairy products and to promote the improvement of the products of the dairy.

The gypsy moth work was also put upon the Board of Agriculture by act of the Legislature in 1891.

By a resolve of 1893 the secretary was directed to prepare and have printed and bound for distribution five thousand copies of a synoptical and analytical index to the fifty-two annual volumes of the "Agriculture of Massachusetts."

The Legislature of 1897 made it the duty of the Board to cause inspection to be made and notice given wherever it is suspected that the brown-tail moth may be present.

Of the voluntary work undertaken by the Board, that relating to the holding of farmers' institutes is among the most important, and one which increases the work of correspondence in a large degree.

The issuing of a monthly crop report and bulletin of information during the growing season is also a great addition to the regular work of the office.

The Board, as overseers of the Agricultural College, by a committee has given increased attention to the duty, with, it is believed, good results.

The library in the rooms occupied by the Board in the State House is a growing institution, which is being carefully looked after. It takes a large part of the time of the first clerk, who is the librarian. A special report, prepared by him, describing the library and his work in caring for it, has been made at my request, and may be found printed in this volume on pages 197–208. It is commended to the

Board of Agriculture and the public in the hope that a further knowledge of what the library contains may lead to a more extensive use of its privileges. It is open to the public during business hours.

In these and many other directions the Board of Agriculture and its secretary are endeavoring to be of use to the agriculturists of the State. The volume "Agriculture of Massachusetts" for 1897, containing, as it does, the lectures and discussions at the public winter meeting, the reports of the committees and business of the Board, the report of the Hatch Experiment Station, the report of the Cattle Commissioners, the statistics of the several incorporated agricultural societies, a directory of the various agricultural organizations of the State, together with other valuable and interesting papers on agricultural matters, is believed to be the equal in value to any of its predecessors, and is commended to the attention of the farmers of the State, for whose benefit it is printed and distributed by the liberality of the State of Massachusetts.

WM. R. SESSIONS,
Secretary of the State Board of Agriculture.

BOSTON, February, 1898.

Meetings of the Executive Committee

of the

BOARD OF AGRICULTURE,

1897.

Meetings of the Executive Committee,

acting for the board.

Boston, Jan. 30, 1897.

The meeting was called in part to consider the request of the Franklin County Agricultural Society for the approval by the Board of Agriculture of the vote of the said society "to mortgage the real estate of the society for a sum not exceeding twenty-three hundred dollars, to liquidate the debt of the society." There was presented an attested copy of the call for the meeting and of the vote of the society above quoted, which copy stated that the vote was passed by affirmative vote of two-thirds of the members present and voting.

There was also presented a copy of the "Greenfield Gazette" of January 23, containing the required advertisement of the hearing.

No person appearing in opposition to the vote of the society, it was

Voted, To approve the vote of the Franklin County Agricultural Society, above quoted, in accordance with the provisions of chapter 274 of the Acts of 1890.

The matter of bills for the regulation of the sale of concentrated commercial feed stuffs, which matter was referred to the executive committee at the recent annual meeting of the Board, being in order, it was

Voted, To adopt the second bill, with twelve hundred dollars as the amount to be inserted as the sum to be allowed the Hatch Experiment Station for expense of enforcing the law if enacted.

Voted, That Mr. Kelton, House chairman of the committee on agriculture, be requested to introduce the bill.*

The matter of taking membership in the American Association of Institute Managers, which matter was referred to

* See chapter 117, Acts of 1897.

the executive committee at the special meeting of the Board at Greenfield, being in order, it was

Voted, To authorize the secretary to take such membership, if he concludes that it is likely to result to the advantage of institute work in Massachusetts.

BOSTON, March 3, 1897.

The meeting was called in part to consider the request of the Berkshire Agricultural Society for the approval by the Board of Agriculture of the vote of the said society, at a special meeting duly called for the purpose, Feb. 23, 1897, that "the president and treasurer be authorized to increase the loan given by the Greenfield Savings Bank, and secured by mortgage on the fair grounds, from $5,500 to $7,000." There was presented an attested copy of the call for the meeting and of the vote of the society above quoted, which copy stated that the vote was by two-thirds of the members present, and that a quorum was present at the said meeting. There were also presented copies of the "Evening Journal" of February 9 and 16, and of the "Evening Eagle" of the same dates, containing notice of the special meeting above referred to, and also copies of the "Evening Journal" of February 24, 25 and 26, containing the required advertisement of the hearing.

No person appearing in opposition to the vote of the society, it was

Voted, To approve the vote of the Berkshire Agricultural Society, above quoted, in accordance with the provisions of chapter 274 of the Acts of 1890.

A request having been received from the Worcester Agricultural Society that it might change the dates assigned by the Board of Agriculture for the holding of its 1897 fair, in order that its dates might conform to the dates decided upon by a joint committee of the Massachusetts State Grange and the Worcester Agricultural Society for the holding of a joint fair, namely, August 31 and September 1, 2 and 3, it was

Voted, That the Worcester Agricultural Society be allowed to change the dates for its 1897 fair to August 31 and September 1, 2 and 3.

A request having been received from the Massachusetts Horticultural Society that it might change the dates assigned by the Board of Agriculture for the holding of its 1897 fair (annual exhibition of fruits and vegetables) to September 30 and October 1, it was

Voted, That the Massachusetts Horticultural Society be allowed to change the dates for its 1897 fair to September 30 and October 1.

BOSTON, April 2, 1897.

A communication having been received from A. C. Varnum, Esq., chairman of the committee on Agricultural College and education, stating his wish that he be relieved of his position on the committee on the ground of continued ill health, the executive committee of the Board was consulted by letter, and appointed Mr. George Cruickshanks, the second member of the above-named committee, to be chairman; filled the vacancy thus caused by transferring Mr. Wesley B. Barton from the committee on domestic animals and sanitation to the committee on Agricultural College and education, and appointed Mr. Oscar S. Thayer to fill the vacancy thus caused on the committee on domestic animals and sanitation.

BOSTON, June 24, 1897.

The meeting was called in part to consider the request of the Plymouth County Agricultural Society for the approval by the Board of Agriculture of the vote of the said society at a special meeting of the society on June 12, 1897, "that the president and treasurer be authorized and directed to execute sixty bonds of one hundred dollars each, payable in ten years, and bearing interest at the rate of five per cent per annum, the same as the one which has just been read, viz." [here follows a copy of the bond]. "*Voted* unanimously, on motion of R. W. Nutter, that the treasurer be and he is hereby authorized and directed to sign, acknowledge and deliver, in the name and as the act of the Plymouth County Agricultural Society, the deed which has just been read, conveying to Augustus Pratt and Charles C. Thayer and their heirs and assigns all the real estate owned by this society, with the buildings thereon, in mortgage and in trust, for the benefit

of the holders of the bonds the issue of which was above authorized. *Voted*, That the State Board of Agriculture be requested to approve the action of this society, authorizing its treasurer to execute a deed in mortgage and in trust for the benefit of the holders of the bonds the issue of which has been authorized."

There was presented a newspaper published in the county, the "Middleborough Gazette," of issue of June 4, containing the call for the special meeting advertised in accordance with the by-laws of the society; also an attested copy of the vote of the society above quoted, which copy stated that the vote was passed by the affirmative vote of two-thirds of the members present and voting. There was also presented a copy of the "Bridgewater Independent," of the issue of June 18, containing the required advertisement of the hearing.

The president of the society, Mr. I. N. Nutter, appeared and explained the condition of the society and the necessity for the action it had taken.

No person appearing in opposition, it was

Voted, To approve the above quoted vote of the Plymouth County Agricultural Society, in accordance with the provisions of chapter 274 of the Acts of 1890.

The committee on gypsy moth, insects and birds presented a recommendation, as follows: —

"*Voted*, To recommend to the Board of Agriculture that notice be immediately given to the mayor and aldermen of the cities of Somerville, Cambridge, Malden, Medford and Everett, and the authorities of other places that may be found infested with the brown-tail moth, that the pest has appeared in their municipalities, and that with the notice there be sent a copy of the law and a bulletin of information giving directions for dealing with the pest. Also that an inspection be made of the territory supposed to be infested, at an expense not to exceed one hundred and fifty dollars, and that one hundred dollars be expended in printing bulletins of information, and a sufficient sum be expended for printing notices, and that the sums above mentioned be taken from the appropriation for incidental expenses of the Board."

Voted, To approve the recommendation of the committee on gypsy moth, insects and birds.

A written request having been received from Mr. Francis S. Thacher for employment in cataloguing the library of the Board, it appearing that there were no funds available for such work, it was

Voted, To postpone action indefinitely.

BOSTON, Oct. 12, 1897.

The meeting was called to consider the request of the Worcester Agricultural Society for the approval by the Board of Agriculture of the vote of said society, passed at a special meeting of the society on Oct. 2, 1897, "that the treasurer be authorized to raise the sum of eleven thousand dollars by a mortgage upon the property of the society, at a rate of interest not to exceed four and one-half per cent, and that the entire amount of the old mortgage and the eleven thousand dollars additional be included in the mortgage." The vote was unanimous in favor of such mortgage.

A copy of the vote as above was presented, with certificate of the secretary that it was "a true and accurate copy of the records of the Worcester Agricultural Society, so far as it relates to the vote to mortgage their property, passed Oct. 2, 1897."

It was also shown that the special meeting of the society was legally called in accordance with the by-laws of the society, and that it was called for the purpose of voting upon the matter of borrowing money to pay the indebtedness of the society and of securing the loan by mortgage of the property of the society. It was further shown that the hearing by the Board of Agriculture on the matter had been advertised according to the requirements of the Board by the insertion in the "Worcester Spy" and "Telegram," on October 5, 6 and 7, of the necessary advertisement.

No person appearing in opposition to the request of the society, and it appearing that the best interests of the society would be conserved thereby, it was

Voted, To approve the vote of the Worcester Agricultural Society, above quoted, in accordance with the provisions of chapter 274 of the Acts of 1890.

SPECIAL MEETING

OF THE

BOARD OF AGRICULTURE,

AT

TAUNTON.

DECEMBER 7, 1897.

SPECIAL MEETING

OF THE

BOARD OF AGRICULTURE, AT TAUNTON.

TAUNTON, MASS., Dec. 7, 1897.

The Board of Agriculture met in Odd Fellows Hall, Taunton, this day, at 9 A.M., for business.

Present: Second Vice-President E. W. Wood, who presided, and Messrs. Allen, Avery, Baker, Barton, Blair, Brewster, Brooks, Bursley, Clark, Clemence, Cruickshanks, Damon, Ellsworth, Goodell, Goodspeed, Hall, Harwood, Hersey, Horton, Kilbourn, Norton, Pratt, Raymond, Reed, Sargent, Sessions, N. W. Shaw, Smith, Stetson, Taylor, Wellington and E. E. Wood.

The hearing on the request of the Spencer Farmers' and Mechanics' Association for approval by the Board of its vote at its annual meeting, Nov. 11, 1897, "to instruct the president to borrow seven hundred dollars and authorize him to execute a mortgage to secure the same," being in order, the matter was heard. It appearing that the Association had proceeded in a legal manner, that this hearing had been properly advertised, and no person appearing to object, it was

Voted, To approve the vote of the Spencer Farmers' and Mechanics' Association, as above quoted.

The secretary presented and read the report of the gypsy moth committee to the Legislature.

On motion of Mr. J. L. Ellsworth, it was unanimously

Voted, That the report of the committee on the gypsy moth, to be presented to the Legislature, be approved by this Board.

The report of the special committee appointed at the last annual meeting to consider a communication from Dr. Jabez Fisher of Fitchburg, indorsed by vote of the Worcester North Agricultural Society, being in order, Mr. S. S. Stetson, chairman, presented the following report: —

Your committee, appointed to consider the letter of Dr. Jabez Fisher of Fitchburg to the State Board of Agriculture, relative to revised methods in the management of agricultural societies, respectfully submit the following report: —

The committee upon organizing were unanimously of the opinion that they should hold their first meeting with Dr. Fisher at Fitchburg, and therefore, agreeable to appointment, they assembled there on the morning of March 18, where they were cordially received by Dr. Fisher and Mr. George Cruickshanks, also a member of the committee. A few other gentlemen especially interested, including Secretary Wm. R. Sessions, were also present by invitation.

Dr. Fisher was asked to address the committee, after which he embodied his views of the required changes by submitting the following: "Any agricultural society may hold, in lieu of an annual exhibition, not less than six farmers' institutes or field meetings, provided that it shall offer premiums at such institutes or field meetings amounting in the aggregate to the sums otherwise now required to be offered."

The subject was then discussed at length by all the gentlemen present.

In the opinion of Attorney-General Pillsbury, published in the "Agriculture of Massachusetts" for 1893, Mr. Pillsbury assumes that the amount of State bounty to which a society is entitled must be predicated by the amount of property, either real or personal, held by said society the previous year, and that an invested capital of $1,000 shall constitute a sufficient guarantee that the society is doing or is prepared to do some actual work in the cause of agriculture.

Also the Public Statutes, chapter 114, section 4, provide that every society receiving bounty shall make such rules and regulations for the distribution thereof as shall in its opinion best promote the improvement of agriculture. No requirement is made by the statutes relating to agriculture that societies shall necessarily hold fairs or otherwise assume any undue expense in conducting their affairs except the condition "that no society shall receive a larger amount in one year (as bounty) than it has awarded and paid in premiums during the year last preceding."

The committee are therefore of the opinion that no further legislation, or amendment of the by-laws of the Board, is required, but that societies may at their option continue their present methods or adopt such other management not to conflict with the statutes as seems to each most conducive to its especial prosperity.

On motion of Mr. J. G. Avery, it was

Voted, To accept the report of the committee.

The hearing on the request of the Worcester Agricultural Society for approval by the Board of its vote at a special meeting, duly called and held on Oct. 2, 1897, "that a committee of seven be empowered to sell the property of the society at a sum not less than $200,000, and give a good and sufficient deed thereof, and that the committee be appointed from the floor," being in order, at the request of the officers of the society, because of their inability to be present at this hour, the hearing was adjourned to Thursday, December 9, at 9 A.M., in Odd Fellows Hall, Taunton.

TAUNTON, Dec. 9, 1897.

The adjourned meeting of the Board was called to order at 9 o'clock, Mr. E. W. Wood in the chair.

The hearing on the request of the Worcester Agricultural Society being in order, the secretary of the society, Mr. John B. Bowker, presented the records of the society, from which was read the call for and action of the special meeting held on Oct. 2, 1897; also there was presented by him copies of the papers containing the advertisement of the said special meeting and also copies of the papers containing the required advertisement of the hearing of the matter by the Board of Agriculture.

The petitioners presented the reasons for the action of the society in voting to sell its property. An opportunity was then given for protests against the approval of the above-quoted vote, and several gentlemen spoke in opposition to the granting of the request of the society. After rebuttal testimony had been presented the hearing was closed.

Action by the Board being in order, Mr. Cruickshanks moved that the matter be passed over until the annual meeting of the Board in January.

Mr. Pratt moved as an amendment that the Board take action at the present time.

Voted, To accept the amendment.

A standing vote being taken on the question of approving the vote of the Worcester Agricultural Society at a special meeting held on Oct. 2, 1897, as above quoted, twenty-one members voted in favor of approving the vote and three members voted against approval, and the vote of the Worcester Agricultural Society was thereby declared approved.

Adjourned at 10.15 A.M.

PUBLIC WINTER MEETING

OF THE

BOARD OF AGRICULTURE,

AT

TAUNTON.

DECEMBER 7, 8 AND 9, 1897.

Public Winter Meeting of the Board,

AT TAUNTON.

The annual public winter meeting of the Board was held in Odd Fellows Hall, Taunton, beginning Tuesday, December 7, and continuing through the two following days. The weather was mild, with light rain and snow the first two days. The attendance at the sessions was unusually large and the meeting was in all ways a successful one.

The first session was called to order by Secretary Sessions, who said: —

The hour has arrived when the meeting should come to order. Gentlemen of the Board, you are each aware that our venerable and beloved first vice-president is detained from us by illness and weakness. I have been informed by our second vice-president, Mr. Wood, that at his request Mr. N. W. Shaw of North Raynham will preside at this session of the meeting.

The Chairman. Gentlemen of the Board: I am glad to see so many present at the opening of this meeting, not only those older members with whom I have been so pleasantly associated for the past few years, but also those who are just taking their places on the Board. You all have come here, no doubt, feeling the responsibility of the situation, that there is a large amount of work for you to do, and that it is of the utmost importance that it be done faithfully and well. When I look back on the past and recall to mind the men who formed this Board of Agriculture, their earnest and triumphant work,—such men as Marshall P. Wilder, Albert Fearing, Professor Agassiz, John B. Moore and others equally prominent; when I call to mind that worker for your Board for nearly all his active life as secretary, Charles L. Flint, and he who immediately succeeded him, the enthusiastic and energetic worker, John E. Russell, and not forgetting that worker for the Board, our venerable and honorable first vice-presi-

dent, whom I am sorry to say is not able to be with us to-day,—it seems to me that we must put forth an extra effort to keep the work of the Board up to the high standard it has attained.

And, gentlemen, when you return to your homes, I hope this meeting may be remembered as one that you are glad to have attended, and in the future when you call up the memory of the meeting that you may have nothing but pleasant recollections.

It has been customary in the past, and has been continued to the present time, to invoke on our proceedings the Divine blessing, and I now introduce to you Rev. JOHN P. FORBES of Taunton, who will offer prayer.

Prayer by Rev. Mr. FORBES.

The CHAIRMAN. I will now introduce the ORIENT QUARTETTE of Taunton.

Song by quartette.

The CHAIRMAN. Ladies and gentlemen: I presume you have heard in times past of the Bristol County Agricultural Society. In the absence of the president I have to introduce to you one of the vice-presidents of that society, who is noted throughout the Commonwealth and throughout the United States for the poultry he exhibits in different places. I now have the pleasure of introducing Mr. PHILANDER WILLIAMS of Taunton.

Mr. WILLIAMS. Gentlemen of the State Board of Agriculture and citizens of Taunton and vicinity: The Bristol County Agricultural Society has just elected for president the mayor of Taunton, who has another place to fill on the programme. I was told last evening at six o'clock that I must say a few words to you, but I had not seen the programme and I did not know what was expected of me, so you will excuse me if I give you only a few words of welcome. I will admit that I have been very much interested in this agricultural society, which I have served as treasurer and president for many years, but for the last four or five years my mind has naturally been filled with other business and I find I have gotten rusty. You will excuse me if I do not give you the beautiful address our past president would have given you had he been here to-day.

We naturally think we have a beautiful city, and we hope you will think so before you leave it. I could go on and tell you about our Board of Trade, our public buildings and our skilled mechanics, but that is not what I am here for. I am here to impress your minds that Bristol County is quite a county; that we have three large cities and many flourishing towns; that all the people in these cities and towns belong to the Bristol County Agricultural Society; that we have among our number some bright, successful farmers; that Dighton, Swanzey and other towns of the county shipped more strawberries to Boston than all the other counties of the State; and that all our farmers are here or will be here to try and learn from your honorable body something that will make them more successful in their pursuits.

I certainly hope your stay among us will be very pleasant, and that when you leave us you will wish your stay could have been longer.

The CHAIRMAN. It has been said that it is always all hard work on a farm; that it is all prose and no poetry; but I wish to say to you that we have some poetry for this meeting, and I will introduce to you the poet of the occasion, HENRY D. ATWOOD of Taunton.

Poem read by Mr. ATWOOD.

The CHAIRMAN. We have listened to the poetry of farming, and now we will listen to the wisdom of Taunton. I have the pleasure of introducing to you Hon. NATHANIEL J. W. FISH, mayor of Taunton.

Mayor FISH. Mr. President, members of the State Board of Agriculture, ladies and gentlemen: It gives me great pleasure to welcome here to-day the State Board of Agriculture, which was established, as I understand it, by legislative enactment in 1852. It is this Board that has done so much to advance the interests of the agricultural communities in the State of Massachusetts. I desire at this time to express regret, for I understand that His Excellency the Governor is your president, that he is unavoidably absent and could not be present here to-day.

The city of Taunton may well be called a manufacturing city. We have cotton mills, tack shops, stove foundries and a variety of other industries too numerous to mention. Sev-

eral years ago William Mason laid the foundation in this city for one of the greatest locomotive establishments in this country. Albert Field began here the manufacture of tacks on a small scale, building up a business which in that line was second to none in the world. Notwithstanding the fact that Taunton is a manufacturing city, it is what I call the basis of supplies for this section of the country, north, east, south and west, whose inhabitants are particularly interested in all that pertains to agriculture. Beside, we have the Bristol County Agricultural Society, which is represented on your Board by my friend Mr. Shaw, and it holds its annual fair in this city from year to year.

So far as the city of Taunton is concerned, manufacturing and agriculture go together, and any Board or agent of agriculture who honors us with their presence is bound to receive a hearty welcome from the citizens of Taunton. It therefore, gentlemen, as mayor of the city of Taunton and in behalf of its citizens, gives me great pleasure to welcome you here to-day, and I sincerely hope that your time may be profitably spent, that you will enjoy yourselves and that your meetings will be instructive. In looking over your programme of the exercises I felt as though I ought to congratulate the citizens of Taunton upon having an opportunity to receive such excellent instruction. They probably will attend your meetings. Once again, gentlemen, I welcome you in behalf of the city.

Song by quartette.

The CHAIRMAN. The Board will respond to the welcome through the second vice-president, Mr. WOOD of West Newton.

Mr. E. W. WOOD. Mr. Chairman, in behalf of the members of the Board I desire to thank His Honor the mayor and the vice-president of the Bristol County Agricultural Society for this most cordial welcome. It has been since 1863 the practice of the Board of Agriculture to hold a public winter meeting; at the annual meeting in January we select a place of meeting, and at the same time select a committee from members of the Board living near the locality where the meeting is held to arrange a programme of exercises for such meeting. That committee, with the secretary of the Board, meet and select such subjects as seem most desirable for the

locality in which the meeting is to be held, and secure experts to make addresses upon the different subjects, after which an opportunity is given all persons in the audience to ask questions of the speaker or to enter into the discussion of the subject being considered. The same course has been pursued in the preparation for this meeting. This committee, together with the secretary, have arranged such subjects as were considered to be of the most local importance. They have also secured speakers of reputation to open the discussions and treat upon the different subjects, and then an opportunity will be given for any persons in the audience to ask any questions or to discuss the questions under consideration.

The Bristol County Agricultural Society is one of the original fifteen that organized the State Board of Agriculture, which number has increased, as our poet told us this morning, to thirty-five at the present time. This organization was formed in 1852, and during the forty-six years that have intervened this society has had but six delegates upon the Board: J. H. W. Page of New Bedford, Nathan Durfee of Fall River, Samuel L. Crocker and Edmund H. Bennett of Taunton, Avery P. Slade of Somerset, and your present delegate, N. W. Shaw of North Raynham. These men have all been interested in the agriculture of the State and have done valuable service upon the Board. But it seems to me that I may be permitted without any disparagement to the others to mention the services of Mr. Slade. For twenty-one years he represented this society on the Board of Agriculture, and his long practical experience, united with sound judgment and his long, continuous service, enabled him to render invaluable aid to the Board.

The Board, when it accepted the invitation of this society to meet at Taunton this year, was aware that it was going to a society whose interest as shown at the annual fair (it having the largest attendance of any county society in the State) would warrant good meetings, well attended. We hope these meetings may prove not only a pleasure but that they may be profitable and interesting to the members of the Board, to the members of the Bristol County Agricultural Society and to the public generally.

The Chairman. The lecture of the morning is to be given by one of the best-known institute workers of the New England States, Dr. Twitchell of Maine, who is here and will take the platform and address you on the subject printed in the programme, viz., "Milch cows, structure as relating to production."

Dr. Twitchell. Mr. Chairman, Mr. Secretary and gentlemen of Massachusetts: I am strongly tempted to use a little closer term, and say "old friends." As I have been looking over the audience I find many whom I have met in years past and with whom I have enjoyed social intercourse.

I am not here to-day to instruct you upon this great question which is at the foundation of success in your principal industry in the State of Massachusetts. A friend said to me as I left home yesterday morning, "Are you going to Massachusetts to tell them what to do?" I said, "Oh, no; I am simply going up to talk with them a little." My desire this morning is to promote a discussion, and if I am successful in that I shall have accomplished my full purpose.

Milch Cows, Structure as relating to Production.

BY DR. GEO. M. TWITCHELL, AUGUSTA, ME., EDITOR "MAINE FARMER."

Not long ago I stood one day amidst the flying shuttles of one of our many cotton mills, and as I looked I questioned. On my left, where employees were at work, were looms capable of yielding three hundred yards of woven fabric per week. The attendant was caring for eight of these, making her weekly output twenty-four hundred yards. Over on my right were other looms so improved that one person could care for eighteen to twenty-four, at the same output per loom, making the total seventy-two hundred yards. "What marks the difference?" we asked. "Chiefly the greater harmony in adjustment of parts and consequent reduction of friction," said the official; and then I began to hark back, as the boys say.

Later I called at one of the saw mills on our river, and as I stood there watching it devour logs, I noticed over yonder the old up-and-down saw working its way laboriously through the logs and throwing off daily about six thousand feet of lumber. Hard by was the gang, set at swifter motion and with capacity increased to twenty thousand feet. On the upper slip was the band saw with its musical whirr as it flew on its mission with friction seemingly reduced to the minimum, eating its way through forty-five thousand daily, and saving one inch in every eight cuts. "What marks the difference?" we asked. "Harmony of adjustment and reduced friction," was the reply; and again I harked back. So through the whole field of mechanics might we wend our way, finding everywhere the same lesson and the same experience.

The tremendous energies of man are constantly being turned to the invention of a screw, a hinge, a pivot or a wheel, which will give finer adjustment, and larger as well

as better product. Are my illustrations applicable? Let us see.

First we had the cow, whose maternal functions were natural, and the product, milk for her calf, proportionate thereto. Then came its introduction as food for babes and family use, and skill began to be manifested in directing the energies and developing the brain. So down through the centuries the open book of progress is before us. The steps correspond with those taken by the machinist, and, consciously or unconsciously, the objective point is always the same. Into the whirl of the past quarter of a century the cow entered, and in the rude awakening caused by sharp competition the tremendous energies of man have been directed towards an appreciation of the greater harmony of parts and more complete adjustment of cow machinery. So intense and exacting have been the conditions surrounding, that this problem of structure and its relation to production in factory, mill or tie-up becomes the all-absorbing, all-controlling question with the manufacturer.

Remember that word for it has a deep significance. The farmer who feeds the raw products, grass, hay, grain, etc., to the cow, manufactures milk, the cow being the machine. His neighbor feeds cotton, wool, and sometimes, I fear, shoddy to his machine, and manufactures cloth. The only difference I see between the two is that the farmer's machine is a co-laborer with him, and also that he cannot successfully make good milk from shoddy.

The cow standing before you with a yearly capacity of ten thousand three hundred pounds of milk differs from her early maternal ancestor in two ways, — harmony of adjustment of parts of machine and developed brain capacity, the result of education, this being the influence of the objective mind of the owner on the subjective mind of the cow. Every step taken in this study of animal structure confirms more strongly the fact that mental influences sent out, or going forth from the breeder, bring results in the individual animals of the breed.

Right here I pause to indicate what seems to be a fact lost sight of, — that the will and wish of the breeder must be active with the care-taker of the animals, else to a greater or less degree that will is thwarted. If a dairyman, seeking to

lift the individual production of his herd by breeding, selection and care, employs one whose delight is in the round, symmetrical quarters of the beef animal, he places an obstacle in the pathway of development which will surely delay, if not entirely prevent, the desired end being reached. So much hinges on the will of the breeder expressed through care, selection, handling and *mental control*, that harmony is called for with all agents standing in any relation to the breeder or the cow. So unnatural and intensified are the functions of the profitable dairy cow, that, for further improvement to be possible, the steps already taken, and objective point aimed at, must be clearly known and seen, and every person employed be in full sympathy.

Meeting a young man lately who had received thorough instruction at the hands of one of the best milk producers, and who was returning from a visit to another large herd, I began to quiz him, until finally he said: "It may be all right for that man, but we cannot make milk in any such way. Those cows were upon clean floors, and most of them were standing. *We bed our cows so freely that we invite them to lie down, knowing that the more quiet they are, the more milk they will give.*" That young man will lift the standard of production with any herd over which he has the care. He is not only seeking the harmony of structure in the machine, but he has a definite purpose in mind, and that will control the animal.

Mr. C. M. Winslow, secretary of the Ayrshire Breeders' Association, discarded last year every cow which did not yield sixty-five hundred pounds of milk; this year he sets the standard at seven thousand pounds. But think you this would be possible, even with this expert breeder, if the men under his charge were filled with the idea of beefy structure?

I may be leading your thought out of the field of actual demonstration, but I firmly believe it necessary, in order for a breeder to succeed, that he have positive convictions regarding structure and production, as well as color, etc., and that his thought be impressed on those who care for his animals. In no other way could we have to-day the distinct families of the same breed, known at a glance by the student and breeder. A score of families of Jerseys might be

named, each carrying a distinct family type, but all true to the Jersey standard, shading from the fineness of the Rioter's to the strong, broad faces of the St. Lambert's and Stoke Pogis. I am speaking to you not as a breeder, but a student and observer. In other lines of breeding these facts have been pressed home upon me as emphasizing the great law of mechanics, where harmony of parts with reference to purpose is the central thought.

Milk production is to be the great industry with Massachusetts farmers. Will it pay you a net profit over cost of production next year and the year after? Will your herds and barns be larger and your farm richer in ten years because of your operations? Much depends upon the farm, but more on the selection of the animals which are to furnish the sinews of war. Every cow must be so constituted in structure and will power that under reasonable treatment she will yield six thousand pounds of milk yearly. Every owner must be made alive to the necessity of appreciating and selecting a machine capable of this, and, beyond that, of directing its energies towards greater results. Herein lies the pathway to success in dairy work, and there are no by-paths open to the indifferent traveller. A positive will, a distinct purpose, an ideal, growing clearer every day, and a love for the dairy cow, will give success, no matter what the breed.

As we read the story, written so plainly in the faces and structure of our animals, of the widening process of humanity, it is possible to note how important have been the arbitrary standards, based perhaps on fancy, rather than so-called practical points, and how, also, only by holding firmly to these have the individuality of breeds been preserved.

I am conscious to-day of a dual purpose in coming before you. Our subject has to do with the every-day thought and work of the dairyman, the milk producer or the beef maker.

It acts and reacts upon the pocketbook, through which channel man is most easily and directly influenced, and fits the needs of the hour as no other can. It has to do with the food of support for the family and its production. But over and above this there is in my mind the reflex influence coming back to the individual who observes, or fails to

observe, the lessons which claim attention at the present moment. These closing days of 1897 bring us face to face with complex conditions and relations, whether in the field of commerce or agriculture. Competition is spreading its net-work of feeders into most remote sections, and compelling the eastern farmer and breeder to prepare for a sharper contest than the past has ever known. Iron bands are reaching out. Space is being annihilated, and sections remote a few days ago are brought near to-day, and made to contribute to the great cry for daily food.

The abnormal development of maternal functions in animals is wasting nerve force with tremendous rapidity, and diseases once unnoticed creep into flock and herd unbidden and unwelcome. Dealing, as you are, with the food of support for so large, and yet so weak, a portion of humanity, the question of health as well as production faces you to-day as never before.

Driven by competition to seek the largest possible output, you must, by a study of harmonious conditions and relations, seek also, and with the same wise energy and constant study, the health of every individual animal under your care.

As breeders, distinct characteristics are to be preserved, and for success the fact of normal health, unequalled vitality, large production and constant service must take the place occupied in some measure by fancy markings and symmetrical proportions. The cow of to-morrow must be *strong*, *vigorous*, *able* and *willing*, and with the great majority breed will hereafter be subordinated to *these four* essentials.

Are we creatures of circumstances? Yes; but we make the circumstances, which are the stepping-stones of progress. We are controlled by our environments, but these too are largely our creations, or come by our neglect.

The cow is the creature of her environment, not willingly, but by reason of subjugation to the will of her owner. She but speaks the thought and purpose of her controlling power, as she in return acts and reacts to control herself. Here is the dual purpose to which reference has already been made.

Man is at the head. Circumstances, environments and conditions are the tests of manhood, the measure of capacity.

In the great realm of natural things he finds largest scope for his powers, the broadest field for investigation. Only as he seeks for the greater harmony at the heart of things can he to-day realize, and only as he realizes can he make surrounding circumstances conserve the higher development of himself and his animals.

Once the man who sought pleasure or profit in breeding animals was looked down upon with pity, if not contempt. To-day, conscious that he is delving in the greatest mystery of mysteries, that of life itself, he stands the peer of any man in any vocation.

Trace the development of the dairy or beef type from the day when only the thought of perpetuating its species controlled, and the evidence of man's intense application may be read at every step. That cow to-day, yielding to higher influences, conforms to the environments surrounding her, and pours out the larger measure of blessing for mankind. She is not an accident, but represents a wealth of time, study and expenditure the world cannot appreciate.

A cow is not a cow simply because she has horns and gives milk, no matter if her pedigree traces to the gates of the mythical Garden of Eden. Here is where we have blundered in the past. Don't be mistaken; there are ciphers in the animal as well as human kingdom, and ciphers do not swell totals. The day has come when a broader conception must be established for every man breeding or keeping stock. Backed by blood, there must be individuality, and that is based on structure and education.

We cannot comprehend structure for special purpose only as we realize what is involved *in purpose.* You measure the worth of the loom which doubles the daily output of a single individual only as you feel the significance of what this increase must mean to the manufacturer and consumer. Looms come in response to demand for larger output at reduced cost, that natural vantage may be retained.

Structure of animals may be accidental, but not to be maintained save as men are made conscious of controlling forces, and seek a better knowledge of frictionless relation between parts, with special reference to output. No man can breed and hold the type, in any department, who is not

fully alive to the necessity for ultimate product and able to direct the environments of his animals.

I make these assertions, not new to any, because no study of this great problem of structure can be of service save as the man is master of the situation. If conditions are exacting and the situation critical, be thankful for the opportunity and the impulse to be larger men.

Admit that structure controls purpose, and at once the fact comes home that there must be special lines of structural conformation in order for greatest harmony in performing special service. It is with special-purpose animals we have to do, and this thought alone claims attention. One hundred and twenty to fifty pounds of butter and three thousand pounds of milk mark the limit with the general-purpose cow. Two hundred and fifty pounds of butter and five thousand pounds of milk mark the minimum possible with any man who expects to-day to sell the raw products of his farm, and realize market rates in the resultant product following feeding. In the sure increase of milk and dairy products, and sharper competition next year, three hundred pounds of butter and six thousand pounds of milk must be the standard. Get these figures solid, for they will stand. Even though, as specialists, your herds range far and away above the limit, the lesson bears as heavily on your shoulders as any.

Mark you, the word "average" does not appear, and it will be well if it is stricken out of the breeders' vocabulary, for there will be no room for averages in the work of 1898. Animals must be regarded as individuals, their worth to be determined solely by individual output, in proportion to cost of production.

For this to be possible there must be a well-constructed, evenly balanced, frictionless machine, every part in harmony with every other part. The bearings and adjustments of this wonderful machine will be in direct ratio to the appreciation of the owner of ultimate purpose.

For this reason a thorough study of structure throughout the entire animal economy becomes an absolute necessity with every man breeding or keeping cows for profit, or expecting to be recognized in the demand of to-morrow. Great as has been the advance of the past, the greatest curse of Massachu-

setts agriculture to-day is profitless cows, and the cause for these rests upon this neglect of appreciation of the imporance of structure and definite purpose. Breed has been the one thought with the farmer, pedigree the chief standard of merit with the specialist, and fancy points, arbitrarily fixed by those whose chief conception has been beauty lines, have influenced, and do influence, more than this question of utility. We have sworn by the book rather than the cow. We have stood by color of switch and tongue, until udders have been lost; width of stripe and size of spot have outranked evidences of utility or constitution. Type must now be made paramount to breed. Structure made the chief essential.

There will be found wider variations between animals of the same breed than between those of any given type though of different breeds. Blood there must be, for improvement, but it must be based on individuality, and this rests on structure. Never was there such a demand for the aggressive, progressive specialist as to-day; but arbitrary points, not in harmony with the practical needs of the hour, based on actual performance, must give way for the essentials by which the door to profit is to be gained. The breeder of any family or breed who has reached six thousand pounds of milk or three hundred pounds of butter from each and every mature animal, under business methods of feeding, has not neglected his study or appreciation of blood, though his cows show looseness of structure, angularity of frame and lack of symmetrical contour.

My cows are Jerseys, Ayrshires, Holsteins or Guernseys, say the fármers, as though that of itself solved the problem of profitable production, whereas it simply indicates certain characteristics. If for the dairyman one or more of these breeds outrank others as dairy animals, the question is not solved by selection of breed, for no man has been able to eliminate all off conditions and able to control structure and temperament in every animal. *The high degree of excellence and great uniformity seen in these essentials simply indicate possibilities when efforts are concentrated along the one line of utility.*

For profitable dairying there must be an infusion of blood of one of the breeds named, but with it there must also go a

sharp discrimination along structural lines. While it may be questioned whether structure determines or controls temperament, it must be conceded that there is a large degree of harmony between the two. Interpret structure in its broadest sense, and it covers the field completely. More than bony frame or fleshy tissue is involved. No man will realize what milk and butter production is until he comes to a study of brain development and recognizes how intimately all are connected with structure. Every breeder should stand before his animals able to say as did Pope, when speaking of man, —

"There stands a structure of majestic frame."

The benefactors of the world have always been of the nervous temperament. They conserve rather than serve themselves. Trace the history of civilization to the present moment, and each epoch adds increased emphasis to this fact.

The good coming from the phlegmatic reaches its ultimate end only by conversion through other channels. Such temperaments store up, gather in, house for their own good, but never outpour. It is in the realm of active nervous force that one finds the largest channel of benevolence; and when this is applied to animals it manifests itself in willing service, the giving forth of energy to the utmost, the volume depending first upon harmony in structure and then on ability of owner to appreciate capacity and direct environment.

Milk, and especially butter production, are the product of nerve force, controlled and increased through brain development. The dairy cow of to-day, sensitive, easily disturbed, a bundle of nervous energies, demands far different treatment from the general-purpose cow of other days. We have here an abnormal development of maternal functions, and the measure of the output will be the capacity of the owner to direct through education, and establish through sympathetic relations. A close bond of sympathy there must be, the owner standing in the relation of teacher and friend.

We are dealing with subtle forces, and large men are necessary to comprehend ten thousand pounds of milk yearly, or five hundred pounds of butter. He who grasps most of the functions of motherhood, and in his breeding and care

stimulates these by just and proper treatment, will reap the largest harvest of gain both in dollars and in manhood.

No man can be a true student of this problem of structure, as related to purpose, without being led out of himself and made to see something of the largeness of little things lying all about. He touches the hidden springs of life, reaches after the mystery of creation, and out of research comes to know the worth and dignity of life itself.

Study cows, but more than all study functions as indicated by structure. Engaged as you are in establishing your own individual family of this or that magnificent breed, let the thought of type be uppermost, and weed, and breed, with special emphasis laid upon the most harmonious structure throughout.

Intensify powers of maternity by allowing them freer scope. Set the trend of individual desires along the line of intensive production. Cultivate natural tendencies, and bend *all* towards one given centre. In this way there must follow a family alike in type, uniform in production, prepotent in breeding. Here is the doorway to future farm operations. Men talk of the hardships of the farm as compared with the mill and shop. There are hardships there, but they will never be removed by keeping our eyes fixed on the small end of the business.

Men with large conception, definite purposes and determination, will be reaching out after the solution of the great problem we are discussing to-day, and, reaching, find that larger life which will bring its compensations. Failure never comes from positive, but negative, thinking; and there is nothing negative in a good dairy cow. She inspires and reflects bright things. If we believe in the farm home and the home farm, there is a work for us to do in checking the drift of the present moment, in bringing to the forefront the fact that there is a way by which men may put their energies into the problems on the farm, find substantial returns, and make men of themselves while so doing.

Nowhere is there a better opportunity than when engaged in transplanting our conceptions and desires upon the animals under our care, and making them willing servants to work out our purposes.

I so firmly believe in the fundamental truth at the heart of this problem that I want to see the dairymen of the east cast their lot for a larger comprehension of this principle of structure, because it, and it alone, will lead to that weeding out of inferior animals, and that critical selection of blood lines most likely to insure individual worth in coming generations, — cows possessing most positive virtues.

A generation must pass before the weeding process will be intelligently applied, and to prepare for the future and *establish types having special reference to purpose* is the demand of the hour. Could you wipe from the State of Massachusetts to-day every cow incapable of yielding a net balance at the end of the year, you would lift the heaviest burden now resting like a pall on many a farm. Could you arouse men to make sharp and clear tests of their individual animals to-day, giving or seeking to give each the food and treatment best adapted to its needs, the cry of poverty on the farm would be hushed to a whisper so faint that it could scarcely be heard.

Let us be thankful for conditions which make mental growth and activity a necessity, for it is out of these, and these alone, that capacity is increased and full manhood insured. Let no man be content with what he has, while furnishing every opportunity for it to do its best. The limit of production will ever be an unsolved problem, resting entirely on the skill and intelligenee of man. Not in dwelling on what is, but in seeking for what may be, will there result improvement. Ideal conditions must be made clear to the individual man and animal, — ideal structure fixed as the sole purpose in breeding. The larger the conception of what is involved, of what one would have, the more rapid the approach towards fruition. It is only in large conceptions that smaller results are brought to full realization. Seeking for the higher, the lower adjust themselves.

He who reaches for a herd every one of which will yield five hundred pounds of butter yearly, will more rapidly bring harmony in structure and increase in output than he whose conception is on a lower level. For this reason more time needs be given to the study and appreciation of structural parts and their relation. In this study one's ideal takes more

definite form, becomes more real, and through this environment the cow yields to the wish of her owner. It is impossible for improvement save through our ideals; and to fix them clearly and distinctly in mind, so that consciously and unconsciously they will exert their influence, requires a large appreciation of the fundamentals expressed in structure. Study variations in form, not in general, but detail, and with an eye single to purpose. Note the effect upon temperament, and finally production. Search for the machine constructed throughout to perform the largest possible service with the least waste of energy, and on that build mental activity by judicious development of mental powers. Cows are machines; like clay in the hands of the potter, they are to be moulded and fashioned; but over and above this there lies the fact that they are intelligent beings, and that production depends greatly upon the measure of education.

Nature stands waiting to reveal her secrets. All down the ages has she been knocking at the door of man's intelligence, asking admittance. In the roar of the thunder and flash of the lightning she has voiced her power, until man arose to the conception of the fact that she was bidding him harness with silken cords the giant forces and use them for his advancement. So through individual animals she has been bidding us enter and occupy the broader field of production, come up higher into the larger conception of life, its uses and purposes; and as men have, here and there, answered the call, nature has linked arms with them for results before impossible. Accidents were these, but they whispered possibilities to the aspiring breeder as he sought to fix the channel of their production and make it strong for future generations. Good business to-day demands a clearer insight into the gospel of cow structure, that, first of all, men may come to see more clearly, have a better appreciation of what they now have, and open the door to larger returns from individuals. There must be an uplift of thought and purpose as to what is possible, as well as a sharper insight into the fundamental truth at the core. Out of all this will flow results, and conditions will be controlled.

Centuries ago Michael Angelo wrought his ideals upon the old cathedrals of Rome until his head grew back upon his

shoulders; yet to-day his conceptions are the admiration of the world, and thousands bow in reverence before them. He wrought upon cold marble with chisel and mallet, he painted world pictures with pigment and oil, but he made every touch pregnant with life and inspiration. We are building upon living structures, our tools are living tissues pulsating with purpose. Consciously or unconsciously our ideals are taking form, rising before us as monuments to our skill and insight into life's great lesson, or the unmistakable evidence of our failure to grasp the true mission of living and find the reflex influence of noble endeavor.

For a few minutes I want to turn to my charts. I have brought with me to-day photographs of four cows. Two are perhaps thoroughbreds, one of unknown breeding selected from an immense herd in one of the ranches of the west, and one represents the almost ideal beef type of the present time. One cow produced twenty-two pounds and a fraction of butter in seven days. Another has a record of ten thousand three hundred pounds of milk a year. Over there is a cow produced on a ranch in Nebraska and brought east. The first year she made nine thousand three hundred pounds of milk.

Glance at the three which constitute the dairy type, and see the marks of similarity between them. There are points to criticise in all, perhaps, for the perfect cow has not been found; but the points in each case are those which mar the harmony of the machine and retard its operations. I spent months and months trying to get a photograph of a cow that I could put before an audience and criticise less than any other. Notice the broad face, the intelligence of the eye, the ample brain capacity and evidence of development, the thin spinal column rising above the shoulder blades, with the high pelvic arch, lacking perhaps somewhat in the size of the barrel, but carrying in her general make-up so many points of a good animal that she is able to make all that is within her centre towards a large milk production.

Take this cow with a milk production of ten thousand three hundred pounds a year. You see here some evidence of the beefy type in the heaviness of the neck, the straight back and a lack of the high pelvic arch. She offsets that by

her enormous capacity for food, the large udder with the immense milk veins and the very flat shoulder and thin legs.

To measure an animal from tip to tip, and give due value to each and every part, is something difficult to do when selecting a herd; but there must be some lessons of value in structure. It must be the objective point with the individual breeder to find the animal with as few obstructions in the machine as possible. It is important to select a breed in order that those points may be intensified.

Notice this cow: the distance between the horn and the eye; the breadth across the forehead; the brain capacity; the immense nostrils, telling of great lung capacity; the extremely thin spinal column all the way through; the thin neck; the withers rising very high; the high arch; the large barrel; the thin shoulder; the large food capacity; the udder, which is of good size and shape; and the milk veins, which tell the story of circulation. I have never been able to find a cow which I thought better illustrated the dairy type than this animal, and the points of similarity between the three are apparent at once. Against that put the round, heavy-quartered beef animal, as indicating the opposite type, and between the two extremes you may range all the cows of Massachusetts. Towards which will the great majority tend?

How are we to increase the number of large producers? By the selection of individual cows, then by the selection of the males to be used in breeding. More attention should be given the dairy type of the males. Masculinity first, but that may well end at the shoulders. Let the dairy conformation be manifest in the physical structure of the male. A watchful eye should measure the udder development both of the males and females. Look very carefully to the rudimentary teats in the males. The time is coming, I think, when breeders will discard the deep, pendant udder, that is always carried at a loss of nervous energy, and approach what is known as the Ayrshire type. Then there will be less loss of nerve force when in motion. We have all seen some of the best cows waste tremendously because of the force caused by a breaking down of the udder, the tissues giving away as the animal carries such an enormous amount of milk. The udder I have mentioned will be higher behind, broad on the surface,

and also extend well forward. This udder conserves rather than wastes nervous energy.

The more you seek the comfort of the dairy cows, the larger will be the output.

Right here I want to raise another point. I leave it for others to discuss. I have noticed repeatedly in my own State that wherever there is an outbreak of tuberculosis it is always in the best animals of the herd, — the heaviest producers.

Is it not true that the animal which gives you six thousand pounds of milk requires more oxygen than the animal giving three thousand? Too many of our barns are built on the three-thousand-pound plan. May we not find the solution of this question by opening our tie-ups and increasing our conception of what six thousand pounds of milk must mean to the machine? Are we not putting an obstacle in the way of that machine performing as it would otherwise perform? By increasing the amount of air in our tie-ups may we not find one of the steps by which we may increase the output of the individual cow?

The CHAIRMAN. The Doctor will be ready to answer any questions that may be asked him, and I hope many will question him. He is able to bear it and ready to answer.

Mr. GEO. E. TAYLOR (of Shelburne). I would like the speaker to explain what he means by mental control.

Dr. TWITCHELL (turning to chart). Here, at the brain, is the seat of milk production; here, at the udder, the source of supply. As the channel between this point, the brain, and the udder is most free and open, so, other things being equal, will the supply be largest. I mean first of all the development of the natural functions of the brain which tend in a cow in one direction or the other, — tend, I say, either in the direction of milk or beef. In one way or the other the natural tendencies will be set if left to themselves. We intensify through our own individual conceptions, our treatment, our care, our feeding. No man can lift production above the standard of his ideal. We come nearest to that when it is more clear. It is the positive, purposeful

mind of the owner controlling the animal which is by every means and instrumentality leading out of itself to larger conceptions and production.

Dr. J. B. LINDSEY (of Amherst). How about the mental capacity of the beefy type?

Dr. TWITCHELL. The mental capacity of the beefy type is more sluggish. We intensify that by our mental conception, — by our idea of what a beef animal must be. Men in my State who are lovers of the beefy type breed the white-face almost altogether. Such men have not succeeded and cannot succeed with dairy animals, but they reach a grand success with beefy types. I believe firmly in the intelligence of our animals.

Mr. TAYLOR. Do you believe a breeder can produce an animal according to his idea?

Dr. TWITCHELL. No; and yet there is a qualification there. I will say this, that the men who have been breeding for the last twenty-five years by the most exact methods come the nearest to it. Poultry raised by a man breeding with a definite purpose for generations can be identified north, east, south or west. But there has not been with our Jerseys or with our Ayrshires that continuity in breeding there has been in poultry.

Mr. TAYLOR. Does the capacity to produce depend on the will power?

Dr. TWITCHELL. There must be the capacity in the machine to do the work, first. Having that, I believe production depends on educated, intelligent, well-developed power, physical and mental.

Mr. GEO. CRUICKSHANKS (of Fitchburg). How early in the life of the animal will it show the type of the dairy cow?

Dr. TWITCHELL. Very early. I have said — and I want to stand fairly and squarely — that I am not speaking from the stand-point of a breeder, but from the stand-point of a student. If there is any merit in what I say, accept it; if not, cast it aside, — but not until you have settled the fact that it is useless. I am not speaking from theory wholly, but from years of investigation and comparison, during which time I have been in touch with some of the best breeders of

the country, as we have been working out these points together.

We fix the tendencies in our animals before they are six months old, and I think that the dairy forms may be determined before the calf is two months old, in the evidence of intelligence, in the dairy-udder development and in various ways.

Mr. N. B. Baker (of Savoy). How long can that cow that yielded that enormous amount stand up? Should we not have a limit?

Dr. Twitchell. I think so. All machines have a limit. That cow was one of the most noted Ayrshire producers of the country. The record she made was a remarkable record, but she was always a remarkable producer.

Mr. Baker. I asked the question because of the fact that a neighbor of mine brought up a cow to twenty-one and one-half pounds of butter in seven days. The cow was about four years old. In two years' time she gave out, broke down, and to-day is dead.

Dr. Twitchell. That might be a very natural result. Before we bring our cows up to ten thousand three hundred pounds of milk we must be prepared to care for them upon a ten thousand pound basis, else they fail to maintain themselves. But it is true that we have not reached the normal capacity of our animals except in very rare cases.

Dr. Lindsey. Why did that animal break down? What was the cause therefor?

Mr. Baker. It was considered to be over-feeding, — trying to keep her up to that standard.

Dr. Twitchell. That is an assumption in part, and I am going to admit that it is correct, but I do not feel that it determines anything. Before you can settle the question, it must be known what the conditions were, where the cow was housed, how fed, how she was treated through all the time during that year and the year before, before you can say absolutely what was the cause of the breaking down.

Question. I would like to ask the objection to allowing a calf to suck its mother.

Dr. Twitchell. You would obtain a good beef animal in that way. The slightest approach to fatty tissues in a dairy

animal is an obstacle in that animal's pathway. The feed after the first twenty-four hours should be with special reference to the animal's ultimate product.

Mr. W. B. Barton (of Dalton). Which animals would be most likely to reproduce? the one of unknown breed or those of known breed?

Dr. Twitchell. The one of unknown breed is more or less an accident. Assuming that she is of unknown breed, she would not be an ideal animal to breed from if she gave a much larger quantity of milk, unless you mate with her a prepotent sire. There would be an element of uncertainty in breeding from that animal. The steps of progress in breeding are slow, and they are not secured through accidents. They come by continuous and persistent effort along certain lines. The hit-or-miss method of breeding is the chief cause of having so large a per cent of inferior animals, and why we make advance so slowly. Systematic work is what is needed.

Mr. ——. I want to cite an instance in regard to raising dairy animals on new milk. There was a certain party who raised two calves that were equally well bred. One was fed on new milk and the other on skimmed milk after the first two weeks of its life. Both came in at about the same time, — shortly after they were two years old. The one raised on skimmed milk made on an average two pounds of butter a week more than the one raised on new milk, and gave almost two thousand pounds of milk a year more than the new-milk calf. At a year old the new-milk calf was the more attractive, and in the majority of cases would have been the more salable animal. The trouble is, we are looking for beauty, — for attractive animals.

Dr. Twitchell. It was with a great deal of diffidence that I came before you to discuss this question, firmly as I believe in the truth at the bottom of it. But, gentlemen, I believe that the path to success in breeding lies in wise selection and in continuous breeding along certain restricted lines. The moment you introduce a new animal, that moment you introduce foreign elements, which may or may not result harmoniously.

Dr. Lindsey. I am intensely interested in this subject, and I do not think we should for a moment wander away

from it. A very practical thought for us to carry away with us is that we ought to endeavor to improve our herds in the lines in which Dr. Twitchell has directed, and I think an illustration can be made in this way.

You take a steam engine, or a locomotive, if you please. There are some that can run thirty miles an hour, and the moment you endeavor to force them to forty miles an hour you are overworking them. Perhaps there is another with a forty or forty-five mile capacity, and when you attempt to force it to fifty or sixty miles an hour you are overworking it, and it is going to give out very soon. What we should aim at is to increase the capacity, so that an engine with a capacity of thirty miles will run forty miles with a reasonable amount of fuel. So it is in this case. We must have a good machine that will take food and turn it into milk and butter, and we must bear in mind this building up of dairy type.

Just one illustration from experience. I had in our station barn an animal which had been in the barn two years before I had anything to do with the matter. At the end of two more years, without any increase of feeding beyond what I called a good normal feed, she broke down. I found she was used up. I had another type which was not a perfect dairy cow by any means, but nevertheless had a large capacity, thin shoulders and a good muscular development. For the last two years she has never missed a feeding. She is built for the business. She has been in milk fifteen months, and is to-day giving twelve quarts of milk. As soon as you look at her you will see she is built for business.

I believe we are in a very critical condition relative to this milk and butter question. We are having severe competition all about us. You have only to read the daily papers of the west to see what tremendous efforts they are making to improve their dairies. How are we in Massachusetts going to compete with those men in the west who are working so hard to attain success? I believe we are to do it in three ways: first, by improving our machine; second, by reducing our cost of production to the minimum, by studying how to produce raw material at as low a cost as possible; third, not only to have good machinery and good raw material, but to

learn how to convert that raw material into the best grade of product possible. Let me urge upon you not only to endeavor to work along these lines which the Doctor has suggested, but also encourage other farmers to do the same thing. There is wonderful power in example. If we are to put Massachusetts among the foremost dairy States in the Union, I believe we must do it by educating the every-day farmer. He has a tendency to shut his eyes. Let us go home with these purposes fixed in our minds, to see if we cannot help the farmers forward, first, by setting an example, and then encouraging others to work along with us.

Dr. Twitchell. There is one point I want to add to what Dr. Lindsey has so well set forth. Let us not feel that we have reached the capacity of our animals, but give that care and attention by which we may be able to determine their individuality and their value; and in breeding for 1898 secure animals which are distinctly of dairy type. I would add to this a study of the internal structure of the udder. Again I enter, perhaps, the realm of theory, but nevertheless a point worthy of testing in individual experience. A fleshy udder is always objectionable. The internal structure may be determined by feeling of the bag.

Dr. Lindsey. I would like to inquire how the farmers in Massachusetts may improve the quality of their dairy cows; how they are going to raise up a better herd of cows, — milk producers or milk and butter producers.

Dr. Twitchell. I would select with special reference to the structure of the cows to be bred from, and then give sharp attention to the evidences of intelligence in the animal, avoiding those which lack in brain capacity (largely manifested by the head and especially by the eye). Having the udder and other points as good as possible, I would then add by the selection of the male, — first masculinity, then the broad, flat rib, the deep, full barrel, the light quarters with the flat shoulder, the rudimentary teats and the udder-like development, the teats being well apart and not attached to the scrotum.

Dr. Lindsey. Would you suggest that they take the best they have, and then purchase thoroughbred bulls?

Dr. Twitchell. I would always advocate selecting the

best you have, and build upon it. There is so much uncertainty when you buy a thoroughbred cow as to whether you are in full sympathy with, and appreciate all, the conditions under which she has been cared for, all of which must be known and appreciated in order to maintain her former standard. I would never use anything but a pure-bred male, and I would get behind him and study his mother, reaching as far back as I could. I would find the animal which represented my ideal, then, regardless of cost, I would buy.

QUESTION. Do I understand the Doctor that the yield of milk depends on the brain instead of the stomach? That an animal should be intelligent in order to be a large milker?

Dr. TWITCHELL. There are exceptions. We must not only have form of body and stomach capacity for the consumption of food, but also intelligence of the brain, which must be developed by the owner before we may expect heaviest production.

Mr. WALTON HALL (of Marshfield). In regard to raising heifer calves, how would you feed?

Dr. TWITCHELL. I would feed on skimmed milk and good hay, and turn to pasture when a year old. Feed only those foods which will promote bony tissue rather than flesh. One of the greatest blessings that ever came to the farmers of the State of Maine is the milk separator. The farmers are finding in the freshly skimmed milk the best possible feed on which to raise dairy cows. I am proud of the State of Maine when I speak of her dairy cows, for our farmers are keeping and growing a grand lot of healthy, vigorous, heavy producers.

QUESTION. Would you recommend raising our own calves?

Dr. TWITCHELL. You can go to Brighton and buy cows that have enormous udders, but you are not always sure to get a valuable cow. Whether you can afford to raise your own is for you to determine. It is the true step to take in improvement.

QUESTION. Why not turn a calf out the first year?

Dr. TWITCHELL. I have found that I could get better growth in the barn on good hay, bran and oats. I would never turn a calf out the first year; I would turn it out the second year. A great many growers in Maine give the calves

a good warm pen in the barn, with bran and some oats and skimmed milk.

Mr. Bliss. Do you mean to be understood that in selecting males to build up the herd there is danger of doing harm by selecting males of different families of the same breed?

Dr. Twitchell. No; I would find the breeder whose thought ran in practically the same lines with my own. Then I would go back of the male and study his ancestors; I would find what was the production of his dam and grand-dam, if possible. Seek to establish the fact of continuity. This indiscriminate mingling of animals of different families is, I believe, the chief cause for the lack of uniformity in the product. Build up by systematic breeding, and not by running after sons of phenomenal performers.

The Chairman. It is nearly time to close the morning session. Later in the day, perhaps, you will have another opportunity to question the Doctor. Secretary Sessions has something he wants to say to you.

Secretary Sessions. I wish to call your attention to the exhibit in the rear of the hall, which comes from the Massachusetts Agricultural College and the agricultural department of the Hatch Experiment Station. You will find there on the tables sheaves and seeds of about twelve varieties of millet, three varieties of soya beans, eighty varieties of potatoes and some thirty or forty varieties of corn. The varieties of corn were grown in rows side by side and may be somewhat mixed, but the type of ear is correct. The fertilizers for the potatoes were applied in the drill in the following proportions per acre: —

	Pounds.
Nitrate of soda,	240
Superphosphate,	400
Sulphate of potash,	250
Tankage,	240
Dried blood,	100

I would say also that Professor Maynard of the horticultural department of the college and station expected to send an exhibit of fruits and horticultural products, but on account of the president, Professor Brooks, Dr. Goessmann, Dr. Lindsey and Professor Fernald being in attendance at this

meeting, and the necessity of their being away so much during the week, and the fact that the college must go on, he could not leave and could not arrange to send it. I am very sorry that this is so.

The CHAIRMAN. After singing by the quartette, we shall adjourn until two o'clock this afternoon.

Adjourned.

AFTERNOON SESSION.

The meeting was called together at 2 P.M. by the secretary, who said: —

The time has arrived for the opening of the afternoon exercises. The vice-president, in charge of the meeting, has requested Dr. GOODELL, president of the Massachusetts Agricultural College, to preside this afternoon.

Dr. GOODELL. Gentlemen of the Board, ladies and gentlemen: We have for our discussion this afternoon one of the most important of the subjects that is to come before you at this session. It is the "Milk supply and the public health." We have with us to-day one who has studied for years the question of sanitation and of public health, one who is considered an expert throughout this country. I have the pleasure of introducing to you Prof. W. T. SEDGWICK of the Massachusetts Institute of Technology of Boston.

MILK SUPPLY AND THE PUBLIC HEALTH.

BY WILLIAM T. SEDGWICK, PROFESSOR IN THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

It is of recent years only that milk supply has come to be regarded as of importance to the public health. Previous to 1881 it was not very generally known that milk is a ready vehicle of infectious disease. It is said that the first epidemic of typhoid fever traced to milk was one in 1857, studied by Dr. Michael Taylor. In 1867 the same epidemiologist showed that scarlet-fever might be distributed in the same way, and simultaneously Prof. Oswald Bell arrived at the same conclusion through his investigation of an outbreak of that disease. In 1877 an epidemic of diphtheria was traced to a milk supply. These and other cases which had been reported were brought together in 1881 by Mr. Ernest Hart, and laid before the International Medical Congress of that year in a striking paper which at once drew universal attention to milk supply as a vehicle of infectious disease. Mr. Hart in his paper gave the history of fifty epidemics of typhoid fever, which up to that time had been charged to infected milk, besides fifteen epidemics of scarlet-fever, and four of diphtheria. "The record," says the eminent medical writer from whom these statements are taken, "since 1881 has not been less striking; indeed, since the method of investigating these occurrences has been more generally understood, milk has been constantly and justly incriminated as a cause of zymotic disease in man."

The year 1881 was important to the milk-supply industry in another and very different direction. In that year a method was invented by which it became easy to investigate with some accuracy the ordinary fermentations of milk, by observing the numerical increase of its bacterial ferments and studying their progressive effects. The same method led

also in other fields to the discovery and elaborate study of the special ferments or germs of such diseases as typhoid fever and diphtheria, and their behavior in milk, from which it appeared that they might readily thrive in that fluid. Further reflection and investigation along these lines have shown that city milk is often in an advanced stage of decomposition, and therefore very far removed from "normal" milk.

It had long been known that bottle-fed babies in cities show a much heavier mortality than those fed normally; and investigations have shown that this is due, in part at least, to the highly unsatisfactory condition of city milk supplies. Investigation has also shown that city milk is often not only falsified but also stale and half decomposed, as well as filthy.

In consequence of these facts, which have been steadily accumulating, and which, taken together, compel physicians and sanitarians to look with the utmost suspicion on city milk, the general public is rapidly becoming convinced that milk is not only of very doubtful purity, — of this it was persuaded long ago, — but, what is far more grave, actually dangerous to use as human food, — at least in its raw condition. Moreover, the fact that tuberculosis is the cause of death of one in every seven and is known to be common in cows, has naturally led many to suppose that numerous cases of this disease have arisen from the consumption of raw milk. Pus, also, is said to be often found in milk.

Importance to Producers of the Good Reputation of Milk from a Sanitary Stand-point.

I need not dwell on this aspect of the subject. Milk is too valuable a product of Massachusetts farms to pass under a cloud without serious damage to the whole community and, above all, to the farmer. In my opinion, the sale and use of milk as a food will soon be very seriously impaired — and indeed ought to be — unless active steps are taken to free it from the dark cloud of suspicion which now hangs over it. If there is believed to be death in the pot, who will care for the pottage?

So serious is this matter, in the minds of sanitarians, that the Massachusetts Association of Boards of Health is seriously

considering the recommendation to the boards of health of Massachusetts of their adoption of a set of rules looking towards the sanitary improvement of the public milk supplies of the cities under their charge. I believe that nothing rash will be done, but I sincerely hope that the way will be pointed out for a great reform in our milk supplies, similar to that which, under the able and wise guidance of our State Board of Health, has been effected in the public water supplies of the State. Happy shall we be if Massachusetts will here once more, as so often before, set an honorable example for the whole nation to follow.

Thorough Understanding of the Problem the First Condition of its Solution.

The milk supply problem, from the sanitary stand-point, is by no means simple. Three great factors, at least, are involved in it, and each has special duties to perform if the problem is to be solved in the best way. These are the producers, the middlemen and the consumers. But, in order to understand the whole situation, let us examine it in detail and in its evolution or origin.

Normal Milk. — The primitive, original and fundamental form of milk supply is that in which the mammal — cow, camel, elephant, goat, sheep or man — suckles its young. In this case the milk supplied by the parent passes almost instantaneously from the milk gland into the stomach of the young, — without lapse of time; without exposure to air or vessels; without human handling, manipulation or falsification, — precisely as nature has prepared it. The only possibility of fault to be found with it from the sanitary stand-point is the possibility of damage from the parent, in case that parent is unhealthy or ill fed. If the parent is healthy and well fed such milk deserves the name of *normal milk.*

Normal cow's milk, then, may be defined as milk as it flows from the udder of a healthy and well-cared-for cow.

Domestic or Country Milk. — Next in complexity comes the private or domestic supply, in which a family obtains its milk from its own cow or cows. This is the system which prevails on ordinary farms and in small villages, and survives sometimes as a coveted luxury of the wealthy even in large

cities. In this case the milk is no longer strictly normal. Between the producer (the cow) and the consumer (the individual who swallows the milk) have come in one or more middlemen, — the milker, the housewife, the housemaid, it may be. Moreover, the milk has been more or less exposed to air, possibly dust-laden and always carrying microscopic germs of fermentation; to vessels — pails, pans, strainers — often richly seeded with similar microscopic organisms; and time has elapsed, longer or shorter, so that these organisms have, slightly or extensively, as the case may be, caused the milk to "work" or ferment. This in itself marks a departure, often trifling but always real, from the absolutely normal milk supply, such as calves and infants naturally enjoy. The sources of danger here are much increased, for it is no longer merely the question of a healthy, well-fed parent as producer; we have also to consider now a possible contamination by the milker, the housewife or other "middleman" before the milk enters the stomach of the consumer, and also those natural alterations which it undergoes after being seeded with the germs of fermentation during the time which elapses between its exit from the teat of the cow and its entrance into the mouth of the real consumer. In well-regulated families, however, the risk of damage so resulting is from a sanitary point of view comparatively slight, and they are fortunate who may enjoy the privilege of possessing a milk supply of this simple primitive kind.

Not by any means the least important fact in this domestic system of supply is the possibility of complete personal acquaintance on the part of the consumer with the sources of his supply, and a consequent control over them. This, as we shall see, he almost unconditionally surrenders when he becomes an ordinary dweller in a great city.

Village or Suburban Milk. — As men come to live in larger villages and towns, some give up the keeping of cows and buy of their neighbors who, in order to supply them, keep more cows. The personal acquaintance of the consumer with the exact sources of his supply diminishes, and his personal control is relaxed somewhat; but he still keeps up a general knowledge and supervision, and may, if he chooses, know and do more at any time. But, as the neighbor who sup-

plies him keeps more cows and more men and more cans, and needs more time to distribute his milk, each source of possible damage to the milk is multiplied, and the departure from normal milk is necessarily constantly greater.

City (*Railroad*) *Milk.*—Finally, as the city grows bigger and bigger the milk farms are pushed further and further away, until a state of things is reached in which the farmer can no longer deliver his milk to the consumer, even with the aid of fleetest horses. The railroad is called in, the contractor, or some similar middleman, appears, and the farmer now becomes merely the producer. But the consumer cannot send to the railroad for his milk, and so another carrier, with special wagons adapted to the purpose, passes to and fro between the railroad and the consumer. This person is known to the consumer as his "milkman;" but as a rule he is a very different kind of person from the farmer, the original type of milkman. In this final form of milk supply the producer may have no idea whatever of the final destination of his milk, and the consumer as a rule neither knows nor cares whether the milk which he buys comes even from his own State. The personal relation between consumer and producer is totally lost, and the middleman comes to hold the position of principal importance, as the only person in touch with all. These circumstances and the very size of the system tend to make it largely mechanical, and all connected with it merely subordinate parts in a great machine which for good or ill works on incessantly.

With the rapid growth of our cities and the development of railroad facilities it is likely that something like the system last described, and which now holds good only for the largest cities, will come to exist to a greater or less extent even in smaller cities, and it is well that we should watch these tendencies, which alike concern farmers, middlemen and consumers.

Sources of the Pollution, Staleness and Infection (if any) of City (Railroad) Milk, and their Removal.

There are three principal faults attributed to city milk, namely: —

1. Filth, — very often observed.

2. Staleness, — usually discoverable.
3. Infection, — occasionally indicated.

Filth in Milk. — This has often been observed and commented on. A dark deposit in a glass of milk is not rare in the city; the so-called "cowy" taste, which often plainly signifies dung; the evidence of the unsavory-looking and more unsavory-smelling separator "slime;" the testimony of the microscope, showing hair, dandruff, hay, dust, etc.; and the appearance of the material held back on the coarser strainer on the farm, — all testify to the now too well-known fact that milk is often filthy. The analyses of Renk and others have simply shown surprising amounts of such filth.

This filth does not belong in the milk. Healthy cows give milk — not filth — from their teats. It comes simply from filthy handling; from the dust of the stable; from the hide, bag, tail and too-often "caked" flank of the cow; from the milker's hands, or clothing, or hat; from unclean pails, or strainers, or cans. It can be avoided, and must be, if milk is to be above suspicion. Cows should receive better care, should be groomed and cleaned as carefully as, or more than, horses. The hands of the milker should be washed before he milks, and the cow's bag should also be carefully cleaned before milking begins. All cans, pails, strainers, etc., should be *thoroughly scalded and sterilized* before they are used to receive milk. For this filth the *producer* is mainly responsible, and to him we must look for reform in this matter. The middleman, however, who "tastes" the milk as it arrives in the city, "mixes," "sets up" or otherwise manipulates the milk, and finally returns the large cans dirty to the producer, is also in part responsible. His cans also are often very dirty, usually imperfectly cleaned and seldom if ever sterilized.

Staleness of Milk. — If milk could be drawn absolutely free from filth it would "keep" a long time; but as this is at present impossible, it must be transported to its destination as soon as possible. Staleness, with decomposition, arises from slow delivery of milk originally seeded with bacteria. Here we must look to the middlemen to do their part in securing quicker delivery and in returning to the producer *sterilized* cans. The present practice of returning to the farmer unclean and often filthy cans is highly objectionable, and the

system of milk "handling" after the milk reaches Boston and before it reaches the consumer might be much improved. I have commented at length on this subject elsewhere in another paper.

Infection in Milk. — The source of infection in milk is believed to be mainly, first, in the cow herself; and, second, in the men who handle the milk. It may be also in the water used to rinse the cans; but in my judgment this source of trouble, while not to be neglected, is much less important. I am often asked whether or not a cow which has drunk infected water can give the infection, — for example, of typhoid fever. The answer is that we have no evidence that she can do so. In regard to tuberculosis, I will only say that it makes very little difference, practically, whether or not the tuberculin test is trustworthy. So long as the milk-buying public is alarmed on the subject, it would seem to be simple common-sense for every milk seller to be able to show that so far as our knowledge goes there is no evidence of the disease in his herd. It ought not to be forgotten that it is a poor plan in business for the seller to ignore or treat as of small consequence the wishes or even the peculiarities of his customers. I repeat, therefore, because it is a matter of practical importance, that the infection is believed to proceed sometimes — in the case of tuberculosis, for example — from the cow herself, and sometimes from the men who handle the milk. An example of the latter class is typhoid fever. Here there is no evidence that the disease can be communicated by the cow; but there is abundant evidence that persons having typhoid fever, either in a severe or a mild form, may, and sometimes do, infect milk if they "handle" it or work about it. Many cases of this kind are now on record; and for improvements in this particular we must look to both the producers and the middlemen. Whoever works over or about milk, whether on the farm, or in the milk-house in the city where the milk is "mixed" and "set up" or transferred to little cans, ought to be especially careful to observe the utmost personal cleanliness, as well as to secure the cleanness of all utensils employed.

The Duty of the Consumer in the City.

Finally, I believe that the consumer has also something to do in this reform movement. I believe that the present ordinary price of milk is too low to allow clean, pure, safe or *sanitary* milk to be produced, transported and delivered with a reasonable profit. I dislike the idea of one price for milk, —good, bad and indifferent. How absurd it would be to have only one price for all butter and all cheese and all meat. True, we have only one price for water and for gas, but then we have only one quality in these. I know of no other food, so variable in quality as milk, which is sold at a uniform price. I do not at present wish to see milk cheaper. I wish first to see it better and if it is necessary, —as I believe that it is, —actually dearer; because milk that is filthy and stale and possibly diseased is dear at any price. I am willing to declare, in season and out of season, to the consumers of milk in cities, that ten cents a quart is as little as good milk, pure milk, clean and sanitary milk, can be got for at present; and all except the very poor can, and I believe will, gladly pay as much as this if they can feel sure that what they get is pure and safe.

Conclusion.

The present state of the milk supply industry is very much like that of surgery previous to 1870. At that time surgeons did their work with no suspicion that they were not clean enough and careful enough. And when, about 1870, Lister showed that air, water and even their instruments teemed with microscopic life, causing inestimable damage in their operations, they were incredulous, if not scornful. To-day every one knows that Lister was right, and that operations then beyond the highest hopes of surgery are now done with safety, simply by observing the rules of absolute cleanliness and exclusion of germ life.

So it is to-day with milk supplies. Farmers and middlemen (and often the consumers also) think that they are clean and careful in their handling of cow's milk, when the truth is their standard of cleanness and freshness and purity is

far too low. Science has moved forward, and they have lagged behind. But as surely as day follows night the newer ideas of absolute personal cleanness, healthy and well-cared-for cows, sterilized utensils and quick delivery in the city, are bound to prevail. Fortunate will they be who shall seize the opportunity to be at the front in this new movement.

The CHAIRMAN. In operations of modern surgery it is not merely the operator and the instruments that are sterilized and kept clean, but the patient himself. So now when you come to the milk question, where the cow is the patient, the cow herself must be sterilized and clean. Before throwing this question open for discussion, I will ask Mr. GEO. M. WHITAKER, the assistant executive officer of the Dairy Bureau, to make a few remarks.

Mr. WHITAKER. Mr. President and gentlemen: I have listened with great interest to Professor Sedgwick, and I am glad the State Board has invited him to be here to-day. It is a fortunate event when the professor, or men of his standing, can state their views directly to the farmers. We occasionally see their ideas reported in the daily papers, but one of the first places for such statements is face to face with the farmers themselves.

As I listened to the professor one thought came emphatically to mind: a point half-way between the summit of a hill and the foot of it may be either "up" or "down," according to the point of view. We may properly use such opposite words as "up" or "down" in referring to the same place or thing. In the few years during which it has been my fortune to be particularly interested in the milk supply, to study it, to appear before legislative committees for a good standard, and to use pen and voice in behalf of the milk question, I have come to the feeling that the quality of the milk supply has advanced part way up the acclivity. At the same time I can see how a man of Professor Sedgwick's attainments may truthfully look at it as pretty well *down*. Although we agree as to the facts, I allude to them with the word "up" while he uses the word "down." Among my reasons for preferring the word "up" are these: Professor Conn of Connecticut, an expert in dairy bacteriology, says the Boston milk supply is relatively the best of that of any city of its size in

the world. I also find, on comparing notes with people from other States, that the Massachusetts milk supply, Massachusetts dairy laws and the enforcement of them stand well in other States. Only a few months ago, while in Detroit, at the National Convention of Dairy Commissioners, I took some pains to investigate the Detroit milk supply. I found that Massachusetts milk legislation and its enforcement stood high there. Still further: the exigencies of the case are such that the supply must be fairly good. Milk cannot be transported seventy to one hundred miles and delivered to customers when it is twenty-four to thirty-six hours old without a fair amount of care; it must have been cooled soon after being drawn, carried in that condition to the cars, kept in refrigerator cars en route, and then kept in cold storage till delivered, to ensure its delivery in a satisfactory condition. Of course I admit that among four thousand to five thousand producers there will be many degrees of cleanliness and care, and that there is much opportunity for improvement.

The trouble with using the word "down" in relation to the milk supply, as Professor Sedgwick does, is that it may lead the public to draw unwarranted conclusions, especially if the criticisms of city milk should get into the daily papers and possibly be dressed up with sensational head lines. The milk supply ought to be improved, and yet milk has been for years a cheap, popular and in the main beneficial article of food. We all want to have it better than it is, but we may unduly injure the business by stating the case from such a stand-point as to fill consumers with unwarranted alarm by presenting to them the most repulsive side of milk production as represented by the most filthy and careless surroundings. There is hardly any food product that would stand such a test, even the making of bread by some city bakers could be described so as to be very repulsive.

I am glad that the matter comes up for discussion here before the State Board of Agriculture, before the representatives of the milk producers, because here is a very proper place for the reform to begin.

The freshness of the supply has been alluded to. Now here is something which we can agitate among the consumers. Boston consumers have the idea that milk must be delivered in the morning, and would resent an afternoon

delivery. But if milk that arrives in the city about ten o'clock in the morning could be at once run through the mixer by the wholesalers, then taken by the pedlers and delivered to the consumers at two or three o'clock in the afternoon nearly all consumers could get milk drawn from the cow that morning. The fashion of a morning delivery adds some fifteen hours to its age. Those who can get the consumers' attention can do good work by educating public sentiment in the city toward an afternoon delivery of milk.

The professor has alluded to another thing which we should consider. He has mentioned the possibility of the boards of health moving this winter for legislation looking to a more careful supervision of the milk supply. I am on record as favoring that. In a paper read before this Board in Dalton I said: "There should be some system of inspection of herds supplying cities with milk, which should take cognizance not only of the health of the animals but of the cleanliness of the stable, the amount of air and sunlight it receives, and the care of the milk before leaving the farm. . . . This inspection should go so far as to include the existence of contagious diseases among those who have the handling of milk and milk utensils." But I added: "There should be nothing about such a law or its enforcement that would subject the farmers to any undue hardship or to annoyance from any arbitrary martinet. It would be well if the agitation should be commenced by the farmers themselves, not only to show that they are interested in the quality of the product they sell, but to insure legislation in sympathy with them, and to see that the enforcement of the law is in the hands of their friends. Such legislation is sure to come, and if the farmers are prominent in securing it, it may be more satisfactory to them than if it is forced upon them."

Though the boards of health have now taken the initiative, yet the farmers should be consulted. The legislation to be asked should if possible be agreed upon in advance by the health interests and the producing interests. The result may be a measure a little less radical than some extremists would like, but it will be an advance step, one which will be workable, one which will meet with no serious opposition in the Legislature, and one which will be followed by no adverse reaction.

The CHAIRMAN. The subject is, "Milk supply and the public health." It is open for discussion, and I hope you will improve this opportunity to ask questions of Professor Sedgwick.

Mr. BLISS. I would like to ask the professor two questions: The first is, Can the disease that we know as "garget" be communicated from one cow to another by the hand of the milker? The second question is, Can the impurities that may get into the milk in the stable all be removed from the milk by passing through a separator? I have always told my boys and the hired man that they were to keep the dirt out of the milk, then it would be pure and clean; but if they got dirt into the milk, it would be impossible to make the milk pure.

Professor SEDGWICK. I am glad to answer these questions as well as I can. The statement I made was that a State veterinarian and pathologist had found a pus epidemic affecting seventy cows, which was attributed to the passing of the germs through the hands of the milker from cow to cow. It is the only case I know of on record, and I only give it as their opinion. It seems to me entirely natural that it should be so. If a man milked a cow that was suffering from some disease and did not wash his hands before going to the next cow, he might get some of the germs on the mouth of the duct, and infect that cow. That is the only case I happen to be familiar with.

In regard to the other question, the gentleman is perfectly right. Some kinds of filth can be taken out by a separator, and enough is taken out to make the separator slime, but it is not all taken out. There are still left in the milk sometimes considerable numbers of bacteria, and of course any dissolved material having the right specific gravity would not necessarily be taken out.

Mr. N. B. DOUGLASS (of Sherborn). I believe the professor is correct. I believe garget can be conveyed by the milker. I had an experience in my herd that such was the case. The first I knew, one of my milkers was having trouble with his cows. The disease began with one cow and had been conveyed by him to the other cows. I dispensed with his services at once, and got rid of the disease. I would

like to know whether garget might be produced by giving too much corn meal to a cow.

Professor SEDGWICK. I am not a veterinarian. I do not know. I shall have to refer you to some one familiar with the subject.

Dr. LINDSEY. I am not a veterinarian, but perhaps I can make a suggestion. I think an inflammation of the milk glands which sometimes is called "garget," might be brought about by feeding. Sometimes garget is caused by bacteria, which has been definitely proved and identified.

Mr. C. D. SAGE (of North Brookfield). I would like to ask if there is any reason why milk cannot be delivered as fresh in Boston as in New York. It reaches New York somewhere about midnight, and is taken at once directly to the consumers' houses. Is there anything to prevent milk coming into Boston being delivered in the same way? I have discussed this matter with the contractors. I formerly shipped milk to New York, and I never have seen any reason why it cannot be handled as promptly in Boston as in New York.

Professor SEDGWICK. I never could see any reason, either. I was very much surprised to find that we had an inferior system.

I was very much interested in Mr. Whitaker's remarks, which seem to embody a great deal of sound sense. I do not see any reason why our milk cannot be delivered as it is in New York, except that we are accustomed to the other method. It is a very hard thing to overcome. A change would mean practically a complete revolution of the present system. We do not realize what a serious thing it would be. I think a contractor told me it could be done if it seemed worth while. Mr. Whitaker is right about an afternoon delivery of milk. Some think if milk is delivered at an unearthly hour in the morning it is fresh. The milk arriving in Boston in the morning could be just as well delivered at three or four o'clock in the afternoon, and then the householder could keep it until the next morning. The milk would be actually much fresher; but I suppose if milk wagons went around in the middle of the afternoon, the ladies would rise in arms. I was very much surprised to find how peculiar our Boston system is. From an economic

financial point of view it is reduced to a fine point. The covered wagon with a place for the plugs under the milkman's feet is peculiar to Boston. One man and one horse deliver far more milk than in any other city on the face of the globe. The thing is beautifully systematized from a financial stand-point. There has not been any intentional neglect of sanitary precautions. In fact, the utmost care is taken to prevent the souring of milk. The amount of acid in the milk is very low indeed when it arrives in the city.

I see no reason why the New York system could not be adopted here, except that we have a system that it is very hard to change, precisely as it has been very hard in New York City to get rid of horse cars, — not that New York is necessarily less progressive, but there is a lot of capital invested in the horse cars. In a town where a new road is being put in, they use the latest plans because it is the simplest thing to do. These eight and one-half quart cans would have to be changed, — at least it would be convenient to change them, if we were going to adopt the New York system. I think in time it may come about. I do see the hope for a great deal of cleaning up.

In regard to what Mr. Whitaker said, I want to second his ideas. It is not that the consumer wishes to make trouble for the producer. The much-abused middleman will find it to his interest to co-operate with both consumer and producer. I can say, although I am not here as a delegate, that the boards of health would welcome any co-operation on the part of the Milk Producers' Union, or any body of farmers, or the Board of Agriculture, or anything of that kind. We are all working to a common end, which is the perfection of the system so that the consumer shall get good milk and the producer shall receive fair pay for his pains and trouble. I believe in co-operation rather than standing off and calling one another names. I am delighted to face an audience like this. The farmer sometimes comes to the city and is interested in the milk he gets when he visits his friends.

Hon. T. S. Gold (Secretary Connecticut State Board of Agriculture). I would like to ask when this milk that is delivered in Boston to-morrow morning is milked on the farm. In New York the milk delivered to-morrow morning was

milked last night and this morning. Do you take a longer time than that to get your milk supply to Boston?

Professor SEDGWICK. That is true of some of the New York milk. Some is a great deal older. I was assured by Inspector Martin of the Board of Health in New York, a very able man, that a great deal of the milk that gets to New York at midnight is night's milk and this morning's milk. I do not know what per cent. Obviously not nearly the whole of it. But the Boston milk delivered at the same time to-morrow morning arrived in Boston this morning at ten o'clock, and some of it was this morning's milk, some last night's milk and some of it still older. Mr. Whitaker will correct me if I am wrong.

Mr. WHITAKER. I would like to ask one question which perhaps is not exactly in Professor Sedgwick's line. Would not an afternoon delivery in daylight tend to throw daylight on some of the methods that are not now in sight? If the milk was delivered by daylight instead of by night, the chances for the hired man to adulterate it would be less.

Professor SEDGWICK. I think the question is answered in itself. The contractors' reply would be that it is essential to the present system that the work should be done in the night, because if the man who goes with the wagon were to suffer any interruptions, if he were to stop and talk with the servant girls, or some one in another wagon (not a milk wagon, for there is supposed to be no other), he would not be able to deliver the milk, and I suppose their profits would fall off and the price of milk would rise. Grave consequences, according to this contractor, would follow. I think it would be a good plan, but it would look a little queer to see wagons going around in the middle of the afternoon, and we should have to get used to it. The milk I buy comes to the house about eleven o'clock in the morning, but I would just as soon it would come at three or four in the afternoon.

Secretary SESSIONS. There was an effort made a few years ago to require the contractors to clean the cans before sending them to the farmers. I remember at the hearing the plea of the contractors was that it would be a great trouble to them, that it would disarrange their business and require them to keep another man, and the final result would be that they would have to reduce the price they paid the farmers at least

one cent per can. My recollection is that they made so much of an impression on the farmers in the Legislature that they submitted to the laying aside of that bill, and nothing ever came of it. Those of you who are familiar with the transportation of cans and the condition in which they are sent out from Boston for the farmers to fill, know that in many cases they go out in a terrible condition. That does not fairly express it. The men who buy the milk and retail it, particularly the grocery trade, use these cans as a receptacle for all sorts of waste and filth about the store. Rotten eggs, dead cats and anything they want to dispose of are thrown into these cans, and the cans are sent back to the farmers without cleansing, for their wives to clean. This bill was to compel by law the contractors to send clean cans, and I believe they could do it at so slight an expense that it would not make one bit of difference in the amount they would pay the producers.

Professor SEDGWICK. I am pleased to have that point brought out. I have never been able to see why the contractor should not wash the cans. He says it injures the life of the can. That does not seem reason enough. To show that it is not a great expense, I want to mention the Springfield Association. Any man from Springfield can tell you that this association, acting as their own "middleman," receives milk from a large number of farms, and wash their cans, steaming them thoroughly, at a very trifling expense. I have seen the wash-room, which is quite a small room. It has always seemed to me that the Springfield Association has one of the best arrangements for the care and delivery of milk that I have seen anywhere in the State. They had a case of typhoid fever, and I was called upon to investigate it. It proved to be a man who got milk from the association. The association people threw open their books to our inspection, and did everything they could to hunt the thing down. We found it came from a certain place, and that dairy was cut off, and confidence was restored at once in the whole milk supply. I have always stood up for that association, although I know them very slightly. I know that they wash their cans, which shows that when a number of farmers combine they do not find it difficult to wash the cans. Cans that had been washed might, on account of dust, need rinsing in the

usual way by the producer. The moral effect of unwashed cans is bad on the producer's family. They see them coming back from the city, and they must infer that that is what the city people like, and see no reason why they should take any great pains to clean up.

Secretary SESSIONS. In reference to the Springfield Association, my home is near by (the farm being carried on by my son), and the effect of their sending out clean cans has been that most of the men who buy milk from the farmers to peddle now return clean cans to the producers. They are obliged to do it, to compete with the association. There is no extra charge. The cans that come to my son's farm are all clean. There is nothing to do but air them and fill them.

Mr. WALTON HALL (of Marshfield). I move that the secretary be instructed to introduce a bill into the Legislature requiring contractors to send clean cans to their patrons; that the Dairy Bureau be instructed to introduce a bill requiring a sanitary inspection of stables of milk producers in the State of Massachusetts. I can almost imagine that Professor Sedgwick has worked on some of the farms I know.

The motion was put and carried.

Professor SEDGWICK. He has worked on farms, but not the ones you know. He was brought up on a farm. It may turn out that it is not necessary to secure this particular legislation. It may turn out that the boards of health have already sufficient power to do that. If so, it would probably save some trouble. I should hope, if possible, that some addition to this motion might be made looking toward fraternal co-operation with boards of health.

Dr. LINDSEY. We have a great deal of sympathy for the farmer who is supplying milk to the Boston market. That is where a large proportion of our milk goes. I know that he is obliged to produce it for two and one-fourth or two and one-half cents per quart. I know from personal experience how small the margin of profit is. I have always realized, on the other hand, that efforts are being made from time to time by local boards of health to improve the quality of the milk, and I believe that matter has got to be agitated more and more. The contractor should make an effort, if possible, to pay rather more for milk that he feels reasonably sure is well produced and well cared for before it leaves the farmers'

hands. Farmers cannot all build new barns or plaster the old ones. They have not the money to do it. But I think they can take the old barns and improve the floor a little, put in windows regulated to open from the inside to let in fresh air; they can sweep the barn thoroughly, and take a five per cent solution of carbolic acid and spray all around where the cattle stand, and fumigate the barn with sulphur; then they will have a clean barn. I did it within two years in an old barn that had been built for a great many years. I purchased a sprayer for a few dollars, and a gallon of crude carbolic acid which cost about seventy cents; I reduced it to make a five per cent solution, and sprayed all around the platform and the place where the cattle fed; then I shut the barn up tight, and burned five or six pounds of sulphur in it, you could not see a foot within the barn. When I was through, the barn smelled very clean, and I feel reasonably sure that it is in good sanitary condition. I purchased a syringe for two dollars, and a little tuberculin, and I injected all the cows with tuberculin. I believe almost every farmer in this hall can do the same thing. I do not think it is necessary to pay a veterinarian two dollars a case. I believe if the farmer has an ounce of common sense and a little skill he can do that. I believe he can practically eradicate the disease or keep it under control, and keep his barn clean at a minimum expense. I believe if he has any interest in taking care of his cows, he can, if he does not wish to do the work himself, personally supervise it; he can have the cows kept clean; he can have the milkers wash their hands, and put on a cheap suit which costs seventy-five cents. If the contractors could in any way, shape or manner give such a man a fraction of a cent more per quart than he now gets, I believe it would be a long step forward in the right direction.

Mr. Bliss. We have heard a good deal about three parties in this business, — the producer, the middleman and the consumer. We have not heard very much about the milk inspector. If my observation is right, the milk inspector is very much alive in a good many of our cities. We hear accounts of milkmen being prosecuted, usually because water is found in the milk. I do not remember a case where an inspector found anything else. I never heard of a little water hurting any one, but I am not in favor of putting it into milk.

It seems to me this officer might go still further, and inspect the milk for impurities and also examine the cans. It seems to me the inspector should go very much further than simply look for water in the milk. If a farmer loses two or three hundred hens, an officer at once starts for the hen thief, evidently to interview him and see if there are any feathers on him. I believe there is a better way of setting in motion a system of detection, and I believe if our officers would look after the milk a little further, it would materially improve the quality of our milk.

Adjourned at 3.50 P.M.

EVENING SESSION.

In the evening Hon. WILLIAM E. SIMONDS of Hartford, Conn., delivered a most interesting and instructive lecture on "The triumphs of invention." The lecturer considered the four great inventions and discoveries,—spinning and weaving, printing, steam engine and electricity. A hundred or more stereopticon views beautifully illustrated what the speaker said. By agreement the lecture is withheld from publication.

SECOND DAY.

The meeting was called together at 10.15 A.M. by Secretary SESSIONS, who said: The vice-president has requested me to announce that Mr. J. L. ELLSWORTH of Worcester will preside this morning.

The CHAIRMAN. Ladies and gentlemen: The subject for this morning is "Market gardening with limited capital," and it gives me pleasure to introduce to you Mr. H. W. COLLINGWOOD, editor of the "Rural New Yorker."

Mr. COLLINGWOOD. Farmers of Massachusetts: I do not know just how you conduct your meetings over here in the old Bay State. Where I live, in New Jersey, which I believe has not yet been admitted to the Union, we have a free and easy, off-hand way, and if the speaker makes a statement we do not believe, we make hash of him.

Market Gardening with Limited Capital.

BY H. W. COLLINGWOOD, HACKENSACK, N. J.

A plain story of a small enterprise. That is what I hope to tell you this morning. The enterprise is small, because it is not yet past the growing stage; the story is plain, because sad experience has planed off some of the theories that might have led to a "big story." I have felt for some time that those of us who pretend to be in any sense agricultural teachers are failing to make our meetings as valuable as we might, by shooting too high, and forgetting that ninety per cent of our farmers are still in the primer class as far as scientific improvement is concerned. I want to get to close quarters and use fine bird shot. It may not bore a hole through any of you, but it may sting up a discussion. I have no big stories to tell. I cannot figure out any enormous profits, because I cannot put into cold figures the fun, the happiness and the health our family has dug out of the soil. My little place is only a converted sand heap of twenty acres,—a little bit shaky in the faith still, but growing stronger all the time by the grace of crimson clover and cow-peas. Our little corner of the earth gives us a home and health, and I take it that is all any man ever gets out of the soil. A rich man in New York once gave a great dinner costing twenty-five dollars a plate. The very earth was scoured to produce rich and varied food for the guests. In the midst of that splendor, he who gave the feast sat at the head of the table eating—*a bowl of bread and milk.* That was all he dared put into his stomach. He would have paid five hundred dollars a drop for the water that comes into our mouths, or one hundred dollars a smack for the way our lips come together, when, tired as a dog, we come near a plate of baked beans. Others may tell what can be done by those who can control large blocks of capital, and

who are blessed with the ability to handle capital or labor to advantage. I want to talk to the young man of small means, who fears that he cannot compete with gardeners whose operations run up into the thousands. And here let me say that we do not envy you men who count your glass by the acre, your onions by the million and your cabbage heads by the regiment. On the whole, we feel sorry for you, that you do not have the fun of substituting brains for horse manure in building up your soil.

First let me say that I am an old Massachusetts boy. I was born in Plymouth, and I have carried with me all over the country a great respect for the hard and sterile soil that raised a solid crop of men. In my ball-playing days I could stand in my father's old garden and hit the Pilgrim Monument with two throws of a stone. My belief is that the old garden has produced over two hundred crops of corn, potatoes and beans. The greater part of these crops has been produced, I think, not from the manure that has been applied, but from the soil itself. This must be true at least of the potash, for manure and fish have added but little of that substance. That garden has been dug and raked and dug again at least one thousand times, with implements varying from the Indian's clam shell to perhaps the modern fulcrum spading fork. The constant stirring and working of that soil has made it *give up* its plant food. In my opinion, that is what nature ground the rocks into soil for, — so that it might give itself away to the plant. It seems to me a mistake to say, as we do, that we must *feed the soil.* That is a good way to make the soil lazy. I would say, make the soil give away the plant food it is holding like a miser. I have observed that many good garden lands have been cast aside as worthless, under the mistaken idea that they are exhausted. That is not true. Poor culture has simply made them tired. Many of such lands are still strong, but they have been so handled that their plant food is locked up. My belief is that the place for the man with small capital but large sense is on such lands, where the mistakes of others have obscured their values.

But why cannot the man of moderate means compete side by side with the gardener of large capital and experience? I

may illustrate my point by a bit of my own history. When I was seven years old I went to live in the town of Easton, about ten miles from where we are now. Young as I was, I learned a lesson in social and industrial economy that I can never forget. Farming in those days just managed to hold body and soul together by snapping a string now and then. We lived on a little rocky place of three acres, with one horse, a cow and possibly thirty stupid hens. We scratched and hoed among the rocks in summer and cut the briers in the graveyard for hay. Thirty years ago, if at this season of the year we had a bin full of potatoes (Jackson White) and turnips, two barrels of apples and a barrel of cider, a bushel of beans, a quintal of salt fish and a few sticks of "Taunton turkeys," we were happy and care-free.

How, then, were taxes and grocery bills paid, and how did the old gentleman save up money to send out west to build towns or railroads? In other words, what was our money crop? It was labor!

We sold our fingers and our brains into servitude to the shoemaker. Once a week they brought to the farm a case of uppers and a case of soles. We pegged them together with wooden pegs, and they took them away for sale. That is all over now, but to-day one of the most melancholy objects on the New England farm to me is the little weather-beaten shoe shop, which was formerly the block house from which they fought the wolf from the door. I can well remember the time when our shoe business came to an end. It came just as hundreds of other small individual enterprises have been wiped out. It was a machine, — there is always some combination force of steel and wooden fingers that comes close to putting mind into the brute force of a water fall or a steam engine, — a machine did that work faster and better than we could. I will admit that it made a cheaper and better shoe than we could with our wooden pegs. The world was better off for the change. I am not disposed to deny that, but did not the world also lose something that it needed when those old-time farmers lost their individuality, and when those little shoe shops were nailed up or turned into hen roosts? I think so, and from that day to this it has hurt me to the heart whenever great industrial changes have driven the small

farmer and gardener away from the old business that enabled him to maintain the individuality of his own home. That is why I come to-day to argue for the poor man as a gardener.

Now, what did these farmers do when their work was taken away from them? A few tried gardening, and failed because they half starved their plants. This part of New England was not a stock country, and these men believed in the old orthodox doctrine that somehow nature has given special privileges and miraculous qualities to nitrogen, potash and phosphoric acid when in the form of stable manure. I spent many a day when a little boy with wheelbarrow and shingle picking up the manure which extravagant horses had dropped on the public highway. We practised homœopathic manuring, and grew only the extract of the crop. An old darkey in the south was tried for stealing a hog. The case against him was clear, and his lawyer told him to stand up and throw himself upon the mercy of the court. He forgot the word and said, "I frows myself on de ignorance of dis court." In like manner these farmers threw themselves upon the ignorance of their tomatoes and cabbage, by assuming that these plants didn't know enough to need plant food.

The American soil culture for the past fifty years has been a succession of just such losses of products and hunts for substitutes. At one time New England was the greatest corn-producing section of the country; but one by one great industrial changes have swept over the country, and washed away the ties that once held the individual small farmer to his few home acres. The opening of the Erie canal took New England people away from home, and set them to growing food which they sent back to compete with those who remained at home. The great development of the trunk lines of railroad, the war, the national homestead law, — all these and dozens of others have changed society and industrial development.

In the constant shuffle and jump for new positions that all this has caused, it is no wonder that many of the duller ones have given up and prefer to stand still rather than to whirl with the tide. We sometimes wonder why "the average farmer" is so slow to absorb what we attempt to feed him. The trouble is that we have tried to feed him too much at a

time. We have tried to jump too fast, and he stands dazed and discouraged at the rush of scientific research that is going on about him.

Back in the days when the shoemaking business left us we were told by learned men — most of whom had seeds or plants or fertilizers to sell — that the east would be better off for the change, because it would be the garden spot of the world. Where I live, in New Jersey, that prophecy has nearly come true; yet it is a grave question as to whether the small freeholder or farmer has profited by it. Where I live, the market gardening business has been highly developed. One of my neighbors sells thousands of dollars' worth of strawberries at Christmas. Others are forcing cucumbers, tomatoes and asparagus, so that they will soon fairly compete with you. I think most of them, one year with another, make money; but they make it largely at the expense of those small farmers who have neither the skill nor the capital to compete with them.

Just as our old shoe business was taken from us thirty years ago, certain features of the market-garden business have been taken away from the small American freeholder forever. Our little shoe shop went down before the mighty factory in Lynn. Why? Because one engine in the basement of that factory generated more power than one thousand of our human arms could produce at hammering wooden pegs. The little hand-hoed potato patch has been whipped by the potato planter and digger, and, except in the most favorable locations, the small greenhouse has been roasted out by the acres of glass which you large gardeners have acquired.

I have no doubt that you will truly say that this concentration of glass and heat is destiny, true and well-advised; I have no doubt that it has been a good thing for the world. No one can deny that this change has made what was once a luxury used only by the rich a regular article of food, even for the poor. It is a fact that Americans consume only 3.7 bushels of wheat per capita, while the English eat nearly 6 bushels and the French nearer 8. If we were to eat as much bread as the English do, we would have practically no wheat left for export. That we do not eat more wheat is largely

due to the fact that modern gardening has made fruits and vegetables so abundant and cheap that they have taken the place of other foods. It is this concentration of force by the corporations in market gardening that have made these things possible. True, the world is better for them; yet, as I said of the old shoe business, the world has lost much in independence and I may say in character, in the wiping out of the old business of the small freeholder. It would be better if the American could have followed the trade to the large garden as the old shoemakers followed their trade to the factory. In our State he has not done so. Your average American, at least the Jersey Dutchman, wants to stand up straight at his work. His ancestors came to this country in order to enjoy that privilege. Men from the other side, whose people have been for generations on their knees, in the dirt, not to say their prayers but to pick the tares from among onions and lettuce, have left the American workman standing idly upon his feet.

Another thing that crippled many of our American freeholders is the belief that certain fruits and vegetables cannot be grown successfully without the aid of stable manure. The result of all this with us has been to produce a class of men who are neither fish nor fowl. The counties back among the hills beat them in milk production; the west beats them at growing corn, wheat, rye and hay; and the market gardens of Jersey City beat them to death on what is usually called garden truck. What are these men to do? That is the question of the hour, and to my mind it is of far more importance to the agriculture of this country than any effort to still further concentrate the business of market gardening. The trouble is that most of the discoveries and possibilities which agricultural scientists have dug out have gone to help the few who have been able to organize capital and labor. In other words, science has been of more benefit to the corporation than it has been to the individual.

The best and only answer that I can give to this question is to tell you something of my own plan, and how it has been worked out. I want to tell you just enough of my personal affairs to form a hook upon which you can hang discussion. I have often wondered what my wife could do to support and

educate the children in case I should be taken away. It may be well enough to carry a life insurance policy. I do that, and I call it a good investment. But experience and hard knocking against the world have taught me to believe that a trade or profession or useful work of some pleasant sort is one of the best things a woman can inherit. My conviction is that if I can leave my wife on a little place back from the town, with a knowledge of fruit and vegetable growing, she will be far better able to make a good woman and a sound man out of the baby and the boy than she would cooped up in any town at teaching school or dressmaking. We just made up our minds to go back to the land for the best part of life. And it so happened that at about this time there came into my family a young man of no special training in any line, simply a big, strong fellow, with a good mind and a love for country life. Twenty miles out of New York we found a little place that for the past twenty years has been sucked by tenant after tenant. There was not a piece of sod on the place as large as my hand except along the old fence rows. I will say that the first thing we did was to pull up every inside fence and haul them to the wood pile for fuel. Most of this land was so poor that little besides mullein would grow on it. The soil, like that of many of your hill farms, was originally a warm loam of fair quality, but there was nothing which was available, at least so the tenants said, except weed seed. We picked out this farm for a market garden and a home, to the disgust and amusement of every practical farmer in the neighborhood. I think we were set down as lunatics, when I further said that I had taken a solemn oath never to buy an ounce of stable manure. As a matter of fact, we break most of the rules of market gardening; but my belief is that every rule, except the Golden Rule, was made to be broken, just as soon as the truth got into it and has a chance to expand.

Gardeners in our country seem to consider the following principles as fixed as the north star: First, stable manure is an absolute necessity, — there is nothing that can touch it in effectiveness. Second, soil is only a plate out of which the plant must eat its stable manure. "Don't let the soil, itself, be touched," say our market-gardening friends; "it is too

valuable, — you might hurt it if you made it give up any of its plant food." Third, one must have a good area under glass to provide a winter market, and one must be reasonably close to the city. Now, all I have to say is, that it takes more money than I have been able to hoard, and more labor than I care to board, to run a garden on the rules laid down by some of your expert gardeners. The book farmers and the scientific men tell me that in every acre, one foot deep, of that sandy farm, there are seven thousand pounds of nitrogen, four thousand pounds of phosphoric acid and seventy-six hundred pounds of potash. They also tell me that in the air above each acre there are so many tons of nitrogen, worth over three thousand dollars a ton. As I am not a scientist, I do not find it convenient to dispute these statements; and I must say that the more I work upon that soil and that air, the more I am inclined to think they underestimate the amount. I saw no reason then, and I see less now, why this immense store of plant food should not be utilized. We have worked on the farm with that end in view. I know that some of our scientific men tell us that, while we may grow crops of wheat or grain in that way, we cannot produce profitable market-gardening crops in the same manner. All I ask is the chance to be permitted to differ with them.

Our plan as been to produce crops that compete least with the large market gardens. With us, such crops are strawberries, sweet corn, Lima beans, potatoes, squash, tomatoes and small fruits. We try to work the land so as to make it as nearly self-supporting as possible. We have bought what seems to us the best combination of tools with which two men and one team can do the greatest amount of work. In winter we study to keep the stock which will give the greatest return for the labor of our two men. We did not buy stable manure at first, because we had only a limited amount of money, and preferred to invest it in tillage tools and fertilizers. Our first crop was a light one, but it was all grown with fertilizers. Our soil is light and free from stones, and therefore our tools are mostly of the harrow or cultivator type. We plough but little, most of our work being done with the new style Cutaway harrow. We like to dig and kick the ground over, rather than to turn it completely over with

the plough. My observation has been that heavy dressings of both manure and chemicals tend to carelessness in properly fitting the ground. With the plough, the object seems to be to turn the whole thing over, and bury trash, manure, weeds and everything else out of sight. The harrow is then used on the upper few inches, and then the seed bed is supposed to be ready. I have always believed that one reason why stable manure gives such excellent results is the fact that it is alkaline, and thus reduced the sourness in the soil; for I am convinced that sour soils are about as prevalent as sour tempers. We have noticed that something of this same result is obtained by constant and thorough stirring of the soil so that the air and sunshine may work all through it. As I have said, we prefer the Cutaway to the plough on my soil, because it stirs and kicks the earth instead of turning it over solid. With the time spent in ploughing an acre I can work it over three times with the Cutaway, and I believe it pays to work our soil over at least six times before putting seed into it. My wife can drive the Cutaway or Iron Age two-horse cultivator as well as any man, and she likes to do it, because she thus sets the men free to work at other hand-work.

Most of you have doubtless heard of the wonderful results obtained by Edison in taking iron ore from the mountains of New Jersey. Edison did not go to the rich iron deposits far away from the seaboard. He knew that there was iron in those Jersey hills. Others knew it also, but they passed it by because they said the metal was so fine and so widely scattered that it would not pay to try and mine it. Edison knew it was there, and he set himself to work to devise some scheme for gathering it. For years he has been quietly at work back among the hills. The result is that he has revolutionized the iron industry of the world. Great masses of the rock are blown away from the mountain and crushed into powder almost by their own force in falling. The crushed rock falls past huge magnets, and on these magnets the particles of iron are safely gathered, where they can be removed, melted into blocks and shipped to the seaboard. In one way, we try to do on our little farm what Edison attempts to do amid the rocks. The plant food is there in the sand.

We try to crush and grind the soil, and then, by the aid of crimson clover and cow-peas, to attract this plant food just as Edison's magnets are attracting the iron.

We started with the poorest field on the farm as a manure factory. Some people for whom I have the highest respect seem to think that stable manure must be made in a stable in the old-time way of feeding expensive timothy hay and oats to a horse, and bedding him with rye straw. I know people who in 1892 believed that they could not live without eating porterhouse roast beef. Economy has forced them to it. They find that they can eat a pot-roast or a shin bone, and still retain their standing in church and State. In my travels in Delaware I have seen the cow-pea and crimson clover manufacturing manure faster than a whole regiment of horses. We took a four-acre field, too poor to grow healthy weeds, and worked it thoroughly with the Cutaway. We then broadcasted sixteen hundred pounds of basic slag and five hundred pounds of kainite, and sowed four and one-half bushels of early black cow-peas. The result was an immense growth of vine, which was cut August 15. A second growth at once started from the roots, and this grew steadily until frost. In the mean time we scattered crimson clover seed over the field, and this finally started, and will grow during the winter. The cow-pea vines may be fed to stock by those who care to do so, or they may be used directly as manure, or used in mulching strawberries. We can rent cheap land and grow this crop at very light expense for very much less than we can obtain stable manure. On poor land it is by all odds the greatest manurial plant we can grow. I shall, however, next year make an experiment with the velvet bean, of which glorious things are spoken by southern farmers. The scientific men tell us that the cow-peas and clover will grow if fertilized with potash and phosphoric acid alone, and that they will steal abundant nitrogen out of the air. I have found that to be true to a certain extent, and yet a little nitrogen added to the potash and phosphoric acid will make a greater growth of vine every time. It is a satisfaction to me to realize that every square inch of our little sand heap, except that occupied by the small fruits, is covered with a living crop of green. It was all crimson

clover, but part of the seeding failed to satisfy us, and we broke it up and sowed rye. Another manure factory on the farm is a four-acre swamp, which I will venture to say has not paid for its taxes in the past ten years. We regard that swamp as a bank. We believe that all the neighbors on higher ground have been chipping in each year a little bit of their fertility, which has run down hill and gathered for us in that swamp. One of the neighbors said that he hauled several loads of muck out of the swamp one spring and put it directly upon the corn field, and nearly killed his corn. I did not doubt that in the least. I can take raw crushed oats, and kill the baby with a single tablespoonful. If, however, we cook these oats and let them simmer and stew fifteen hours until they are soft as mucilage, we can build bone and brain in the baby without any trouble. The muck or plant food in that swamp needs cooking, just as your raw phosphate rock needs to be softened or dissolved with acid before you care to put it on your ground. We haul load after load of that muck to a high point on the farm, and mix it with our stable manure and basic slag, and let it ferment or cook all through the winter. Usually by spring it is soft and fine, and in just the right condition to broadcast over the crimson clover for a crop of sweet corn. These two manure factories mean an end to the need of stable manure for supplying vegetable matter.

Of course I understand perfectly that this sort of farming may look like very small business to you men of large operations, who are close to town and who command abundant capital and labor. With due respect for you, I want to say that your large operations have driven us to throw off the yoke of stable manure and to concentrate our labor upon the crops that may be best grown without it. I have no doubt that you grow larger crops per acre than we do, but I believe that ours are produced at as low a cost per unit, and in addition to that I will say that we have neither the capital nor the ability to handle your large operations. Our little place back among the hills gives us a home and holds a family together. It is a pleasure to think that one is slowly gaining where others have failed; and if you big men with your large operations are able to get any better,

truer fun than that out of life, I hope that when the time comes you will stand up here and tell us what it is.

I will now try and speak of our crops and our methods of growing them. First let us take strawberries. With us the only berries that are worth growing are the large, dark-colored, high-flavored fruit, that can be sold "twelve hours from the vine." It is only with such fruit that we compete with the larger growers. We use chiefly the varieties that grow best in single hills, like Parker Earle, Marshall, Glen Mary and Gardiner. We use the hill system for various reasons, chief of which are the facts that we want sunshine on all sides of the plant, and that we usually grow other crops while the strawberry plants are gaining their size. Our plan of growing is about as follows. And now you will understand that when I say "I" and "we" I am simply the talker representing the workers. My wife and the boys really do the work, and about the best that I can do is to play the dignified part assumed by the rooster who crows when the hen lays an egg. Last spring we selected a strong piece of land. I would prefer a level, well-drained field that had been in cow-peas the previous year. This was first worked several times with the Cutaway and thoroughly chopped up. It was then deeply ploughed with a Swivel plough, so that the Cutawayed soil was turned to the bottom. On most of our soil I would omit this ploughing, as the soil is so shallow that part of the subsoil would be ploughed to the surface. After ploughing, the ground was well worked, first with the Acme and then with the Iron Age two-horse cultivator. The object of this was to have the soil well pulverized and aired down to the subsoil. Large and strong plants were dug with the Richards transplanter, and set three feet apart in rows six feet wide. These plants never stopped growing for a moment. Just after the strawberries were set out we planted June Eating potatoes midway between the rows of strawberries. The potatoes were dug in July, and the rows were levelled and worked with the two-horse cultivator. With the Richards transplanter we then set out plants on the potato rows, fifteen inches apart and also in between the old plants. This bed will probably be picked three years, and will then be ploughed up and either planted to

late cabbage or sowed to cow-peas. Next year we shall change this plan, and set the plants four feet apart each way, with hills of early potatoes between the plants. The potatoes will be started on sods in the hotbed and transplanted after frost. We have also transplanted strawberries after clearing the land of peas and Crosby sweet corn. Our Glen Mary potted plants were set out this year on October 16. We have transplanted Parker Earle strawberries as late as election day, and picked a fair crop from them the following spring. Of course such culture cannot be advised for general practice. It suits our condition better than any other, and that is why we follow it.

Peas.—These pay us reasonably well, and the money for them comes at a convenient time. Our next spring's crop will be grown on a light, sandy soil, upon which crimson clover is now growing. This clover will be worked under with the Cutaway. We shall use in the drill a home-mixture of potash, chicken manure, cotton-seed meal and basic slag. Last year's varieties were Nott's Excelsior, New Life and Telephone. The first-named variety may be planted closely. We have grown them successfully between the rows of strawberries. We choose these varieties because they are of excellent quality and sell well in our local market,—a small town, with a limited demand for the best.

Lima Beans.—Bergen County, N. J., where we live, is the greatest Lima-bean section of the eastern States. Our American farmers seem to be gradually dropping the crop, and it is going very largely into the hands of the Germans. The reason for this seems to be that there is an immense amount of labor involved in tying and picking, which is easily done by children. The Germans are growing a larger child-crop than the Americans, and the few children that the Americans do produce care more for a bicycle than for a bean pole. One can often see little tots in the Lima-bean field climbing on chairs and stools in order to tie the upper vines. We grow only the bush variety, either Kumyle or Dreer. Earliness counts greatly in Lima-bean culture. The very first may bring six dollars a bag, while later in the season the price may fall to seventy-five cents. My opinion is, from what I have learned from others, that the bush Lima may be

expected to succeed in many sections where gardeners have failed with the pole varieties. We endeavor to capture the early bird by starting the plants in the hotbed on small pieces of sod, and transplanting to warm early soil as soon after May 15 as danger from frost is past. One trouble with bush Limas is the fact that the bushes fall over, so that the pods are left in the dirt. The best way to prevent this is to mulch with straw, or, on clean soil, one may sow crimson clover early in July. Most of our gardeners seem to agree that fine stable manure is better than anything else for Lima beans and celery. We do not grow celery yet, but have had good results with Lima beans grown upon fertilizer alone.

Sweet Corn. — We find this one of the best crops for distant market gardening. Our experience is that farmers on high-priced land do not attempt to grow very much sweet corn. We generally use for this crop all the manure that is left from the strawberries, and always plant on a rye or crimson-clover sod. The most satisfactory early variety, all told, with us, is Cory. As with Lima beans, a few days of advanced earliness count for dollars. We start the first crop in the hotbed on small sods, and transplant in the open field or among spring-set strawberries. Crosby is our second early, and with us is a profitable variety. Last year we planted Shaker's Early and Early Mammoth, but they did not fill the nick, as the plantings of Stowell's Evergreen came on in time. The Evergreen corn is the standby in the markets near New York, and we made seven different plantings of this variety last year. The Shoe Peg or Country Gentleman is sweeter than the Evergreen, but does not sell so well with us. The kernels seem to be riveted to the cob, and they are certainly death to a soft filling in an upper tooth. At the last cultivation of the sweet corn we always sow crimson clover between the rows, and work it in shallow with a light and small-toothed cultivator. We followed the same plan with squash, melons and tomatoes, — in fact, with every crop where after the last hoeing or cultivating the crop of weeds is likely to cover the ground. Our experience has been that the clover is not only far more valuable than the weeds for turning under, but that it actually crowds the weeds out. I will say, too, that we do not raise or buy any

hay. Our stock is fed entirely upon sweet corn stalks and cow-pea hay. Our work horses have had nothing since October but sweet corn stalks, wheat bran and a little oil meal.

Tomatoes. — Our next year's crop will be grown on a light, sandy field, that produced a heavy crop of cow-peas last year. Early Ruby is the local variety for first crop. The plants are started in a hotbed and pricked out into small strawberry boxes, which will be put right into the hill. Our homemade fertilizer serves well for tomatoes, and, if they do not make a satisfactory growth, it is easy to apply a small quantity of nitrate of soda. My friend Professor Waugh, of Vermont tells me of a scheme for giving tomato and other seeds an early start, which seems to me worth trying. He says that a seed is like a baby with a patent automatic nursing bottle tied to it. The little germ of the seed is to live on the food that is stored up with it until the roots and leaves are large enough to take hold of our manure and fertilizers. Some seeds may be said to be troubled with dyspepsia. The starchy part is so old or hard or tough that the little germ cannot eat it. We have known people to use pepsin in chewing gum and other forms to help digest their food. Professor Waugh suggests the same treatment for dyspeptic seed, namely, soaking them in a solution of pepsin. With him this has given more plants and stronger ones. Any treatment that puts a baby plant or animal on its feet will be felt for good all through its life, and I shall certainly try this treatment.

Potatoes.—Early varieties pay best with us, and we have found June Eating and Bovee very satisfactory to our customers. Most of our crop is grown between rows of strawberries, raspberries and other small fruits. We can use the Robbins potato planter between raspberries, and the tool answers for many other purposes. If we were to try to raise a prize crop of potatoes, we would proceed about as follows: start this year on a warm, well-drained piece of ground, and work it up thoroughly with the Cutaway, probably giving it five or six different workings. We would then use to the acre a mixture containing one hundred pounds muriate of potash, four hundred pounds basic slag and one

hundred pounds nitrate of soda. This would be broadcasted and worked in with the Acme harrow. We would then sow one bushel per acre of early black cow-peas and work them in either with a Breed's weeder or a light-toothed harrow, followed by a roller. We would not touch the field again until the 1st of August, when we would go through and sow, as a venture, twelve pounds of crimson clover over the acre. The chances would be two to five that few of the seeds would sprout on top of the ground among the cow-pea vines, but we would take the chance. The field would then not be touched till the following spring. The cow-pea vines will be killed by frost, and fall to the ground. In the spring, as soon as the soil would permit, we would go on with the Cutaway harrow and chop and cut the soil and vines as thoroughly as possible. This would require at least four workings with the Cutaway, running in different directions. If the soil were deep enough to warrant it, we would then plough as deeply as possible, and not turn up the subsoil. After leveling the ploughed field with the Acme, we would plant the potatoes in rows three feet apart, using the Robbins potato planter, ourselves riding behind, to see that every piece was properly dropped. I think, however, it would pay to plant by hand, in which case we would make a wide, deep furrow by going both ways with the plough. We would drop from six hundred to eight hundred pounds of the high-grade fertilizer to the acre in the furrow. For seed we would use, from our present experience, either Orphan or Carman No. 3, which varieties seem to be particularly well suited to our soil. Three days after planting we would begin work with the Breed's weeder or a light cultivator, and keep the surface of the ground thoroughly stirred up. As the plants appeared above the ground, we would cultivate at least twice a week with the two-horse Iron Age cultivator. This machine straddles the row, and every tooth is under immediate control of the driver. At first we would put the teeth down three or four inches deep, but as the plants grew we would gradually lift them until they merely scratched over the top of the ground. When the plants were about six inches high we would fasten boxes on either side of the pole of the cultivator, with holes in the

bottom. The boxes would be filled with fertilizer, so that this would gradually trickle out in advance of the hoes. This cultivation would be kept up as long as we could possibly get through the row. One excellent thing about potatoes of the Carman No. 3 or Rural New Yorker No. 2 type is the fact that they grow upright. The vines do not fall and sprawl on the ground until they have made a large growth, so that it is possible to work up close to the plants until late in the season.

If I were asked to grow a large crop of potatoes without a year's preparation in cow-peas or some other similar crop, I would not attempt to do it, at least on my farm. One of the best crops we have ever grown on a large scale seemed to upset most of the known theories of potato culture. The ground was thoroughly worked and fair dressings of fertilizer worked into it. Potatoes were planted in shallow drills eighteen inches apart each way and lightly covered with soil. The whole patch was then covered with a coating of stable manure about three inches thick. No cultivating was done during the season and but a little hand weeding was necessary. The plants grew up through the mulch and made a very heavy growth. When they were dug, the ground was perfectly alive with potatoes. It happened to be a dry season, and the mulch seemed to have good effect. I shall try this again next spring on about one-quarter of an acre of early potatoes, using cow-pea vines and marsh hay for mulching. We are not prepared to recommend this method, although, as I have said, it has given us perhaps the largest yield on a small scale. As I said, we follow every possible crop with crimson clover, generally mixing turnip seed with the clover after such crops as late peas or sweet corn. The turnip with us is not a particularly profitable crop. It provides excellent food for our stock, however, and the small ones left with the crimson clover supply a good deal of humus and also a terrible smell in the spring. I have found that some of our neighbors have a greater respect for our crimson clover if the frozen turnips let out large doses of their peculiar odor when the time comes for ploughing under. There are still many of our gardeners left who depend upon their noses for their chemical analysis of manure or fertilizer,

and we find that a frozen turnip gives them considerable respect for the clover crop.

Our stock consists of two horses, one cow and at present about three hundred hens. Most of our present flock of hens were bought in the live poultry market in New York. We watch these markets, and whenever an opportunity offers to buy Brown Leghorn stock at fair prices, we generally buy lots of forty or fifty. These hens cost us on an average of thirty-nine cents each, which is cheaper than we can raise them. We aim to follow the colony system, and keep our hens in portable houses on various parts of the farm through the winter. Our experience is that hens running upon the crimson clover will pick up nearly thirty per cent of their living from it. We feed them a mixed balanced ration, which is easily supplied, and the greater part of the manure is scattered over the field, where it will do the most good. The hen manure saved from the houses is used as a filler for making a home-made fertilizer. We use plaster under the roosts, so that the manure is left hard and dry. It is kept during the winter in a dry place, and usually comes out in the spring in coarse, hard lumps. These are crushed and smashed with a heavy spade and sifted through a coal screen, so as to make it reasonably fine. A mixture of eight hundred pounds of this hen manure and three hundred pounds of nitrate of soda makes a good dressing for almost any crop on our land. If used where the crimson clover was especially heavy, we would drop out the cotton-seed meal and add one hundred pounds more of dissolved rock and fifty pounds more of muriate of potash. We have used a great deal of basic slag or iron phosphate. This has been broadcasted on the land at the time of sowing crimson clover or cow-peas. In fact, we believe in using most of our potash and phosphoric acid on these green crops. The home mixture I have mentioned is used chiefly in the drill, and generally not in large quantities.

I am aware, as I have stated several times, that this method of farming is not appropriate or particularly helpful to the large grower. I do believe, however, that it is along some such line that the man of limited means must hope to succeed upon the soil. And, while I have no quarrel with the large

gardener, and while I hope some day to come nearer to his methods than we can afford to do at present, I do believe it to be good policy in every way to encourage the small man of moderate means to go back upon the hills and take up the neglected possibilities of the old soil, and make it yield for him that greatest of New England blessings, "an independent homestead."

QUESTION. Should crimson clover be ploughed in now, or left until spring?

Mr. COLLINGWOOD. I should leave it until next spring.

QUESTION. Will it be rotted enough to catch the crop next spring by waiting until next spring to plough it in?

Mr. COLLINGWOOD. Yes; plenty. If not, we use a little lime with it, but for corn that would rot in plenty of time.

QUESTION. How would it act on potatoes?

Mr. COLLINGWOOD. I should prefer to use it for corn. I cannot say that I have had any particular experience with potatoes, for all our potatoes are grown between rows of fruit. I would not like to make a statement in regard to it, but my judgment would be that it would be perfectly safe and good policy.

Mr. B. P. WARE (of Marblehead). You started in by saying that the plough must be a back number; that you could get along without it on your farm. Now, it seems to me that you have based your success almost wholly on the use of the plough and stable manure. You stated you could get along without stable manure, but you took that muck and mixed it with stable manure and made a compost that was valuable; you have used stable manure all through your process of farming more or less, and your success has depended largely upon it. You have used the plough, as you could not get under ground the stuff that covers it and have it fit to make a seed-bed for your crops without the plough. I only want you to explain how you denounce the plough and stable manure, when you based your whole success, it seems to me, upon the use of the plough and stable manure, in connection with muck.

Mr. COLLINGWOOD. I am very glad you brought up this point. In regard to the stable manure, I use it on a par with my Uncle Daniel Reed, whom I lived with, who made

patent medicine. When the shoe business was taken away, we went into different kinds of business to keep things going. He conceived the idea of making a patent medicine. He had an idea he could sell it to good advantage. He took buds and leaves of walnut trees, I chopped them, and we put them into the cider press and squeezed out the juice (I am going to give away a secret, — it never was patented). He took one part of walnut juice, one part of well water, one part of molasses and one part of old Medford rum. Then he offered that for sale. It would cure anything, from a sore foot to consumption. We called it "walnut extract." What proportion of it was walnut extract? I look at it this way. I must have the stable manure to start a fermentation in the muck. If left to itself, it will not ferment as quickly as I want to have it. I use it on the principle that Uncle Daniel used his walnut extract. The only use I have for stable manure is to start fermentation inside the pile of muck. If a man should come to me and say, "I have a car-load of stable manure that you can have," I would take it.

Mr. Ware. You used it in fertilizing your crop.

Mr. Collingwood. I would rather have to-day a growth of crimson clover on my field than twenty loads of the finest stable manure that ever came out of a stable. It does not cost me more than a dollar and a quarter which I pay for the seed, and possibly three hours' time to work it into the soil. Wouldn't it be foolish to go and buy stable manure?

Mr. Sargent. We cannot grow crimson clover in all parts of Massachusetts.

Mr. Collingwood. I am not so sure of it. I tried three years before I could get it started.

Mr. Stetson. What time do you sow it?

Mr. Collingwood. Part was sowed the 27th of July; the first was sowed the 17th of July. That was on a piece of Evergreen corn which was then about ready for the last cultivation.

Mr. Elbridge Cushman (of Lakeville). Would you use rye and crimson clover both on your farm? I have thirty acres that I have sowed with winter rye. Would there be any advantage in my introducing crimson clover on the light,

sandy soil of Plymouth County? You were born there. Would it grow crimson clover as well as it does men?

Mr. COLLINGWOOD. I do not know whether I am the only man from Plymouth County here, or not. But, if I were to go there and commence farming, the first thing I would do would be to start crimson clover on my farm. I think that, by working it continually, sooner or later you would get it to grow.

Mr. CUSHMAN. How do you get that crop you consider worth twenty loads of stable manure without any manure?

Mr. COLLINGWOOD. I will pass this clover sod around, so that you can see that it is not tied on with strings. I will say frankly that I think the cow-pea to-day is a better and more valuable plant than the crimson clover, if a man has land enough to let it remain on the ground for a reasonable time. If I had more land, I would have ten acres every year.

Mr. STETSON. Would it not be better to turn it in than to leave it on the ground?

Mr. COLLINGWOOD. If I ploughed it in I would sow crimson clover in the fall. It sours under the soil.

Mr. Collingwood's attention was called to the fact that he had not answered Mr. Ware's second question in regard to the plough.

Mr. COLLINGWOOD. My answer is, my plough is for sale. I bought it under a misapprehension.

Mr. WARE. How are you going to cover that mess on your ground four inches deep without a plough? Your Cutaway harrow would not do it. You could not make a seed-bed unless you ploughed it under with a plough.

Mr. COLLINGWOOD. I have done it.

Mr. WARE. You said you turned it under with a plough.

Mr. COLLINGWOOD. I bought a plough in the spring, thinking I would need it, but it is now for sale. I will sell it for less than I paid for it.

Mr. WARE. You have used your plough a great deal this summer, and I do not see how you could get along without it.

Mr. COLLINGWOOD. I have used it on four acres.

Mr. WARE. Do you pretend to say you can make a good seed-bed with that stuff on your ground without a plough?

Mr. COLLINGWOOD. For what crop?

Mr. WARE. For potatoes.

Mr. COLLINGWOOD. I can for potatoes.

Mr. WARE. You plant corn.

Mr. COLLINGWOOD. I can for corn. I appreciate the fact that I have a very light, sandy soil, that works up easily, and I do not need as fine a surface for my crops as a man would in planting finer seed. I can take a Cutaway and work up the soil for cabbage or corn or potatoes, and those are about the only crops we have. I can set out strawberries without any trouble at all.

Dr. LINDSEY. I want to make just a point. We have grown crimson clover at the station, or tried to. We planted it the first of August or about that time, and it has grown very nicely indeed and has gone through the winter very well, but in the early spring we notice it winter-killed so that when the season began we had hardly a sprig of clover left. In Massachusetts, so far as our experience has gone, it is not a success. I just wanted to make that statement relative to our experience with crimson clover. If there is any way to stop that early spring killing, it would be very gratifying to us all to know how to do it.

Mr. COLLINGWOOD. Let me ask you this. Do you think that using manure or muck on the clover would help to carry it through?

Dr. LINDSEY. I must reply that I do not know.

Mr. COLLINGWOOD. How about the cow-pea? Have you tried that?

Dr. LINDSEY. Yes, sir; but we have discarded it for the soya bean, for this reason, we could not grow the seed of the cow-pea, but we can grow the seed of the soya bean.

Mr. COLLINGWOOD. What is the price of beans for seed?

Dr. LINDSEY. We have been selling it to the farmers of Massachusetts in small quantities, and I think we have charged about a dollar and a half a bushel; the price has escaped me at the present moment. The seed of the cow-pea is about a dollar a bushel.

Mr. COLLINGWOOD. I get my seed in Delaware, but I can grow my own seed.

Dr. LINDSEY. We have not succeeded in doing that.

Mr. James Rankin (of Easton). Allowing that crimson clover would stand our climate, in what is it superior to our common red clover?

Mr. Collingwood. It is hardly a fair comparison, from the fact that the crimson clover makes its growth in such a short time. I can grow it on my soil when otherwise the soil would be barren. It does not interfere with any other crop. With the red clover, you have to make it a present of a year's use of the land before you can utilize it.

Dr. Lindsey. We have no trouble in growing the bean at the station.

Mr. Collingwood. You believe in the possibility of farming with green crops and chemicals?

Dr. Lindsey. Certainly. With your conditions, I think it is perfectly possible.

Mr. Collingwood. If I were to come back to Massachusetts, I should try to use my present arrangement.

Mr. H. M. Thompson (of Easton). Do you think you could raise it without any manure or fertilizer?

Mr. Collingwood. Yes; some of this was grown without anything at all.

Mr. W. F. Taber (of Poughkeepsie). Having grown all these different kinds of green crops for sale and for ploughing under, I think perhaps I might say a word. I grow crimson clover successfully, and have a fine crop now. For one or two seasons when I first commenced growing it, it would not live through the spring. I believe that crimson clover is worth more than it costs.

The question has been asked whether it is better to raise red clover in the place of crimson clover. I will answer in the affirmative, if there is any danger of the crimson clover being killed. I sow both, as the occasion requires. If we can sow the red clover (I use the mammoth) at about the time we would sow the crimson clover, the earlier in July the better, we can get a fine growth of the red clover in the fall to cover the ground through the winter. It starts in to grow in the spring, and there is no danger of its being winter-killed. I sometimes plough it under the first spring. We get a greater growth of top than we get from the crimson clover. There is not stored up in the roots quite as great an

amount of nitrogen as there is in the crimson, but, taken altogether, there is quite as much value in the red clover as in the crimson.

Mr. ——. I have been growing crimson clover in a small way for four years. We have had trouble by winter-killing to some extent. For the last two years I have mixed red clover and crimson clover seed and sown it, and the red clover seems to help the crimson clover to live through. They both make a healthy growth and cost very little but the seed. I like to keep my ground covered with something of the kind. We do not yet know the value of red clover. It should be sowed before the first of August.

Mr. Taber. The clover grows stronger every year. We know it will not grow unless the bacteria are in the soil, unless the conditions are right. If you grow as we do in the vineyards, we find every year the growth is stronger and better, and the more likely it is to live through and not die out by the changes of the season. I want to say that it is now four or five years since I commenced to grow crimson clover. Do not be discouraged because it suffers for a year or two. It is necessary that the soil shall be inoculated with these microbes, in order that the plant shall thrive and grow and be strong enough to withstand the winters. I had it killed for two winters, but for two years past it has lived through. It is the freezing and thawing in the spring that kills it. Yet the fact is that we get more than it costs, even if the crop is killed. We have the richness in the soil, the nitrogen that has been stored in the roots. To show you just what it can do, I was one of the first to plant a crop on a crimson clover seed-bed in our section, it being about half an acre. It was adjoining a piece of corn stubble. The whole was ploughed and treated exactly alike and fertilized in the same way. I planted it to sweet corn, and the growth of the corn was the same until it was about six inches high, then you could almost see the changes every day. That on the crimson clover sod was of a darker, brighter color and grew faster than the other, and all through the season it was from three to six inches higher than the other. But the value came in when we took off the ears for market. In the portion where the clover sod was turned under we

picked from six to eight hundred ears to the row, and the other part did not yield but a little over five hundred.

Secretary SESSIONS. How old was that sod?

Mr. TABER. The seed was sowed the July previous. It is used to cover the ground in the winter and as a manurial crop to turn under. I do not believe it is valuable for hay here, although a great deal is used in Delaware and Maryland.

QUESTION. How late can you sow it?

Mr. TABER. Up to the 1st of September, but I would advise sowing it by the middle of July, if possible. It attains a better growth and is better able to withstand the changes of winter and spring. I have it now covering my vineyard from six to ten inches high. In fact, I had to plough my vineyard a little early, because the clover was getting so large I thought I would be unable to turn it under.

QUESTION. How much do you sow to the acre?

Mr. TABER. I sow twenty pounds. There is a great deal ot talk about twelve and fifteen, but I have had the best results from increasing the amount. I know George Powell sows only fifteen pounds, and he has nearly one hundred and fifty acres covered with it now. I would advise sowing it almost everywhere, that is, so as to cover the ground. I do not believe in bare ground for the winter except heavy soil.

QUESTION. Would you sow it in a young orchard?

Mr. TABER. Yes; certainly. There are many advantages from that. A great many are opposed to this work I have done. In my institute work I found many who did not agree with me at all in reference to ploughing in these green crops. They would say that I better cut it off and feed it and use the manure; but I have persisted in it, and I think I will prove to you that I have been successful.

Mr. H. W. FOSTER (of Tewksbury). Would it not be better to plough it in in the fall and have it rot, then, as the ground is heaved by the effects of the frost, it will be mellow and fine in the spring and everything will be ready for the crop.

Mr. TABER. I want every particle of my ground covered with something during the winter. It is far better, unless

you have very heavy soil and you want the action of the frost on it.

Mr. Collingwood. My objection is this: some of my land is level, but on a slope, and I do not want it washed if I can help it. Again, my experience has been that when we take the cow-pea and plough it under it is liable to sour in the ground. There is so much water in the rank and heavy stems that they start up a fermentation unless a person uses lime constantly. For that reason I would rather leave it on the ground until spring. I do not believe in ploughing it in in the fall unless it is on very heavy soil. I would use the plough on heavy soil, but I have none of that soil.

Secretary Sessions. I noticed, in the remarks of Mr. Collingwood, what might be considered a slur on agricultural colleges. He said he would rather have a young man without any ideas than one from a college.

Mr. Collingwood. I stand here a graduate of the Michigan Agricultural College, class of 1883, and I thank God to-day that I took that course at that college. I want to give you just one leaf out of my life, and tell you what induced me to take that course. When I ran away, I was thirteen years old. I went to school two terms after that, then went to work. When I was nineteen I drifted to Colorado as a cow boy on a ranch, and one day there on the plains I saw two old men talking together and going over their lives. One was a man of wealth. He had ten or fifteen thousand head of cattle. The other was a poor man. The rich man could barely sign his name. The poor man had a college education. And I tell you, as I saw those two men there at the evening of life, side by side, and compared them, the thought came into my mind, What is life after forty-five or fifty years? And I made up my mind then I would go through fire and water if need be to educate myself, and that was how I happened to go to the agricultural college. I went there because that college offered me a chance to work my way through. I milked cows, waited on tables, washed dishes, tried to teach a district school and was thrown out, but I went back again. When we get out of a college we have to unlearn some things. I had to unlearn this, the fact that at the college we had everything in first-class shape,

everything that money could buy. A poor man cannot farm that way. A poor man has got to teach school or edit a paper (no, I do not mean edit a paper) to make money enough to farm on that scale. It took me a number of years to get down to common things and get started on the practical side of life. I said this young man who came to me (my brother-in-law) knew very little about farming, but he was ready to learn and begin anywhere. My honest conviction is that if I took a graduate of a college onto my farm, the first thing he would want would be five hundred dollars for a hot-house, six hundred or a thousand dollars for this or that. Think of striking an editor of an agricultural paper for a thousand dollars! I cannot conceive of it. I speak frankly because I believe these meetings are where we should come face to face. I do think and say that our agricultural colleges, my own college among the rest, have not been reaching down and helping those boys who have nothing to start with. I may be wrong, or stir up a hornet's nest, but these are my convictions. With my limited means, building from an ash heap, give me the boy who knows nothing, and who is willing to work with his hands, rather than the boy who has been educated to do things with capital and with tools of the highest type.

Mr. P. E. Davis (of Taunton, Massachusetts Agricultural College, 1894). Do you think a knowledge of scientific agriculture prevents a man from working with his hands or working with inferior tools or working under difficulties of any kind? I believe thoroughly in the agricultural college, and I believe it is in the man, not in the college, that makes him want a thousand-dollar hot-house or engine. I do not think the college intends to instil into a man any such ideas. I think it is the man, not the college.

Mr. Collingwood. I take men as I find them. I cannot make them over. Let me go back five generations, and I think I could bring out a pretty good sort of a man. I am frankly stating what I believe. I have yet to learn of any graduate of an agricultural college who has gone directly out of the class room upon a farm, without capital, and gone to work with his hands and been successful. I can name fifty such men who work for other people. When I find such a

man who has gone to work for himself, I will take off my hat to him.

Mr. DAVIS. I would be pleased to step up to Mr. Collingwood as one of those. I was born on a Maine farm, and I know what work is. I worked my way through college, and I am still working with my hands.

Mr. COLLINGWOOD. I am proud to meet such a man as that.

Secretary SESSIONS. We keep them in Massachusetts.

Mr. EDMUND HERSEY (of Hingham). It is evident to me, from the discussion which has been going on for the last half hour, that what I have always supposed to be true has been proved here; and that is, that no rules can be laid down by which you can run a number of farms alike. You have got to understand your farm; you have got to understand everything in connection with your farm. If a man goes to college, he has the advantage of knowing how to plant and grow crops and how to feed them to the best advantage; he learns how to select his herd of cattle and how to feed them to the best advantage. When I hear any one speak against our colleges, or who throws out anything which has a tendency to leave on our minds that it is a damage for a boy to go to an agricultural college or that it is not a benefit to him, I always feel that I want to say a word in favor of an education. Let me tell you that the agriculturist, to be successful, requires an education better than that needed in any other profession which man ever followed. You can use the most diversified knowledge on a farm. I could take you to a farm of a few acres where it has been run by direction for more than sixteen years, and the real profits from that farm have come to a point where to-day they will support a small family. Now, why is this? It is simply because intelligence has directed the hands that have worked on it. Now let us, as friends of agriculture, remember that we are to work for the uplifting of our fellowmen, and especially our fellow farmers, by giving them a better education, for on that rests the future prosperity of the farmers of New England.

Mr. COLLINGWOOD. I would be sorry to have you people go away and misconstrue what I said about the college. I am a graduate of a college, and proud of the fact that I spent

four years of my life — four years of hardship and privation — in an agricultural college. But I do think that our agricultural college system is not perfect by any means.

Mr. Hersey. Is anything perfect?

Mr. Collingwood. If I am not mistaken, our agricultural colleges have in the past tended to make classes among the farmers in this way: they have been able to take but a limited number of students, and I do not think they reach down in the homes of the lowly people and try to bring them up in large numbers. I can look back, and I remember that the feeling I had when I left college was that I had given up four years of hard work, that I had not put a dollar in my pocket during those years, and all the boys had been at work laying aside from two to three hundred dollars a year. I did not feel that I could go back and begin as a farm hand. I had got to make that knowledge earn me more money. I had got to make it useful to me. I found there were only two ways in which I could do it; one was in working for a man who had capital, the other was to get hold of capital myself. In other words, I do sincerely believe that the agricultural college has been of more benefit to the capitalists and the corporations than it has been to the individuals. I felt it in my heart that I must go to work for some one who had capital, or in some other line of business, to earn the money with which to buy a farm. I got that idea at an agricultural college. I do not say the college was to blame for it. I believe one of the first thoughts of a graduate from an agricultural college is to secure a position at a college or experiment station, or with some man who can pay him a salary, or work at something that will enable him to start a farm as he would like to start it.

Adjourned at 12.35 P.M.

Afternoon Session.

The meeting was called together at 2 o'clock by Secretary Sessions, who said: Ladies and gentlemen: I want to express, as I think I am warranted in doing, the feeling of the Board of Agriculture that this meeting has been a success, and we want to congratulate ourselves and the people

of the vicinity on the success thus far, and I doubt not it will continue successful to the end. The vice-president of the Board has requested me to call upon Mr. George L. Clemence of Southbridge to preside this afternoon.

The Chairman. The subject we have on this afternoon's programme is one not only of interest to farmers of Massachusetts, but to many of the mechanics living in our manufacturing towns. We are fortunate in having one to speak to us this afternoon whose reputation is known all over the United States and through Canada as a gentleman who has had great experience in this line. It gives me great pleasure to introduce to you the speaker of this afternoon, Prof. Samuel Cushman, who will speak to you on "Advantages and disadvantages of modern methods of poultry culture."

ADVANTAGES AND DISADVANTAGES OF MODERN METHODS OF POULTRY CULTURE.

BY SAMUEL CUSHMAN, PAWTUCKET, R. I.

Mr. Chairman, ladies and gentlemen: I am on the programme as "Professor" Samuel Cushman. I make no claim to being a professor. The title was sometimes given me by courtesy, I suppose, when I was connected with the Rhode Island Experiment Station.

My experience with poultry dates back to the time I was ten years old, when my grandfather, a Massachusetts farmer, presented me with a pair of fowls. A few years later he gave me a hive of bees, and is therefore responsible for the interest I have in poultry and bees. He is still living, I am glad to say.

In my experience as a fancier, in breeding and selling poultry for exhibition and breeding, also as an experimenter along practical lines when at the Rhode Island Experiment Station, I have gathered some ideas which perhaps are a little different from those who have produced poultry only for market.

A word about the poultry industry. Almost every one now realizes its great commercial importance. It is estimated there are 380,000,000 fowls in this country, that the total earnings of poultry are $290,000,000, and that the industry represents a permanent investment of $240,000,000. Whether these estimates are correct or not (they are probably too low rather than too high), it is a fact that from 1887 to 1890, when eggs came into this country free of duty, there were from 13,000,000 to 15,000,000 dozen imported each year. During the same period less than 2,500,000 dozen were exported any one year. In 1892, under a duty, the yearly imports dropped clear down to less than 2,000,000 dozen, and since then have gone no

higher than 4,250,000 dozen. In 1897, fiscal year ending June 30, only 579,681 dozen were imported. Our yearly imports have dropped from $2,000,000 worth in 1889 to only $47,760 in 1897. Meanwhile our exports have increased from 372,772 dozen in 1887 to 1,300,183 dozen, year ending June 30, 1897, — an increase in value in exports from $60,686 in 1887 to $180,954 in 1897, or nearly three-fold.

Although there has been a very rapid development of the poultry industry during the past few years, it has not been overdone. This country can yet handle all the poultry products. There is a large increase in the number of eggs consumed per head of population every year, and this, and the market value of the product, would be much greater if they were properly collected and distributed and delivered to consumers without such great delay. There is an enormous loss on the egg crop of this great country between its production and consumption, and most of it is unnecessary.

Besides our home market, there is a foreign market for eggs. England and Germany are the best egg markets of the world. They do not produce 60 per cent of the eggs they consume. During 1895 the United Kingdom imported daily an average of 4,000,000 dozen eggs (209 tons), or paid out nearly $50,000 every day for foreign eggs. During 1896 she imported $20,000,000 worth of eggs. Germany in 1895 imported over $17,000,000 worth, and in 1896 paid nearly $19,000,000 for foreign eggs, — an increase in value of $1,100,000. She also paid that year $4,000,000 for imported poultry. Russia wins the lion's share of the egg trade of both these countries, although many shipments reach England by way of Germany. Other European countries secure some of it. Canada not only produces her own poultry and eggs, but ships quantities to England. As yet this country is out in the cold. Lately she has sent about one-seventh as many as Canada. The United States sends her wheat and corn to Europe, sells in competition with Russia, India and South America, and leaves the bulk of the foreign egg trade to other countries. It costs less to ship poultry and eggs than grain, and these products take less from the land.

We were told by Professor Alvord at a meeting in Rochester, N. H., last week, of what the government was doing to promote the market for American butter in England. It would seem that Secretary Wilson was doing a very wise thing. Should not steps also be taken to secure more of the foreign market for eggs? There may be no such congestion of poultry products to make this very necessary, but it will be easier to win the foreign trade now, while this country leads all others in its methods of poultry production, and when grain is high, than later.

Eggs from Iowa, Kansas, Missouri and Illinois can be put on the English market just as well as butter from those States, if fresh when collected and prepared for shipment. French eggs reach English cities in better condition than those produced in the interior of the home country, while eggs from Australia have been sold in London as high as fresh eggs from France. It is said that eggs from the United States have sold in England next in price to those from France, while Russian eggs have sold for less than those from Germany and Belgium.

The State of Massachusetts imports millions of dollars' worth of eggs from other States. Why is it that farmers all over the State do not produce the home supply? It is the same in Rhode Island. A large part of the eggs consumed come from without the State. We do not, perhaps, want to sell our eggs for what western eggs bring, but we are not obliged to do so. We can deliver them when fresh. If of the highest quality, they also ought to bring an extra price.

The eastern farmer can surely make money on poultry, even in competition with the product raised where grain is cheap. What is the best way to do it? We all know there has been a great improvement made in methods; still, people think there is very little to it until they have taken it up as a business, then, after a few years, they change their opinion, and realize they must know it thoroughly to succeed. Those who undertake to teach how to do it are generally fanciers and pure-bred breeders, who have stock they want to sell, rather than poultry farmers, and the advice given is not always disinterested. Even editors do not like to publish the faults of the different breeds, as it offends

their advertisers or subscribers who admire them. The public really has hard work to get at the facts. The inexperienced have to try half a dozen breeds to learn which are most suitable, and then may not know. Thousands repeat the same experiments. This would be needless if the reliable experiences of a few were made public. A great expense would thus be saved the country.

There is a large number of poultry papers. The methods taught in most of them are adapted to the fancier rather than to the poultry farmer. A few have lately come out on other lines, however, and accomplished much good. Too many of the agricultural papers have simply echoed the teachings of the fanciers' papers, but they are now looking more after the poultry farmers' interest.

As with market gardening, boot manufacturing and other lines of business, the specialist and large producer is getting a grip on the business; but there is a chance for the small operator, and especially for the farmer.

The more complicated the poultry specialist makes his business, the more skill it requires and the greater his chances of failure. The risks are greater, as well as the profits. He uses breeds adapted to a special purpose, buildings planned to save labor, secure sanitary conditions and best protect his stock, follows the best methods of feeding, and, above all, has a defined plan to be adhered to and carried out in every detail. He is thus enabled to secure at a slight cost the very best product, even when there is a great scarcity, and when it will bring him the very highest price.

There are all sorts of breeds, and perhaps each has some particular special quality that is desirable. Each season they are being improved, and new information gained as to the best and cheapest methods of management. Therefore the up-to-date man must constantly study the problem. There is a demand for one-and-one-half-pound broilers in certain cities. There are breeds specially suited for their production. Years ago, practical men thought these were of no account. The fancier kept them for his pleasure, and distributed them, and thus preserved them; but the practical poultryman took no stock in that breed, -- now they make practical use of them.

I do not believe it is best for every farmer to undertake to follow the specialist; that he can produce poultry and eggs cheaper and at less risk, — if he does not adopt such extreme methods. The farther he goes from the old methods, the more work he must do, and the greater the care required and the greater the chances of disease. The old pioneers did not have to take the precautions against disease that people in cities now do. If you keep large numbers and follow improved methods, your obstacles are greater. The specialist who confines his flocks in yards and provides all their food the year around, may secure a greater product than if they were allowed free range; but fowls thus cooped are wholly dependent upon their keepers. If you do not give them fresh water, gravel, meat and green food, they suffer. If the yards and houses get foul, they cannot get away, and must breathe the fumes. The successful specialist cannot be guilty of such neglect, but it has been my experience that many farmers who attempt to improve are. We do not approve of dropping boards, as a rule, for this very reason. Those who take up advanced methods, build modern buildings, get good breeds, and then fail to carry out the details, are worse off than if they were following old methods.

I have seen men who kept bees try to improve, and have a similar experience. They understood just how to keep them in the old box hives, and make a little honey and money every year. It was no great thing, but was pretty sure, as far as it went. A few years after they had taken up modern methods, there were no bees on the place. It was not the fault of the new hives or methods, — they had simply gone farther than they understood, or would carry out the details. The farmer should remember that he must work from a different stand-point usually than the fancier. My advice to the farmer is to adopt the breed and management best suited to his circumstances. It is better even to keep bees in box hives, or poultry in the old way, than to strike too high a key and fail entirely. If he cannot give the extra care, labor and attention, he should not adopt the houses, breeds and fixtures that are suited only to those that do.

It is usually desired that something definite be said in regard to which is the best breed. It is the one best suited to

your place and personality, and whose product sells the best in your market. There are many different breeds, each having qualities suited for some special purpose. In some the various extreme qualities of several have been combined, and they, although not as good for any one special purpose, are fairly good for all purposes, and therefore popular with the majority who do not follow a special branch.

Each breed differs under different management, and in different sections of the country. Each has undesirable, as well as desirable, qualities. Some markets call for white eggs, and others for brown eggs; some require yellow poultry, while others will take anything that is plump and soft, regardless of the color of skin or legs. If you want to produce winter eggs, you want one thing; while for the largest number of eggs in summer you want another breed. Certain breeds are very hardy, and can stand exposure and hardship; while others, more prolific, are very tender. Some are very quiet, and fatten very readily; and others are so active that it is impossible to get them fat. There are those that excel in flesh production, but in little else.

Brahmas and Cochins are of great value to the industry, on account of their hardiness, and always will be. They are not hustlers, like the active breeds, but stand cold and confinement well.

The non-sitters, the Minorcas, Leghorns, Hamburg, etc., are the greatest layers; but, unless protected from cold and damp and given considerable liberty, they will contract disease. The old English game, the Cornish Indian, the Malay, Black Java and Aseels, as well as the Houdan and Creve Cours, are great flesh-producers, but are less hardy than Chinese breeds, and much less prolific than the non-sitters. We have these different classes combined in the Wyandottes and Plymouth Rocks. They are rather too beefy to make the best layers, and not as hardy as the Cochin, Brahma and Langshan; but, as they are fairly hardy, fairly good layers and good flesh-producers, they meet the needs of the majority. They have enough of the beef and hardy blood to be quiet and withstand cold, and produce brown-tinted eggs and lay well in winter. Their worst "out" is a tendency to get so fat by the second year that they are no longer profitable egg-

producers, and therefore must be marketed after the first season. The non-sitters, if given liberty, are profitable the second and third years.

If your market prefers white eggs, and you do not care to market table poultry, I believe the Black Minorca is the best breed for you. If you wish a white egg-producer that has yellow skin and legs, the largest strains of white and buff Leghorns would be my next choice. For a hardy winter layer of brown eggs the Langshan stands at the head, but the dressed poultry cannot be sold to advantage or at all in some markets. It is, however, excellent for your own table. Black pin-feathers are objectionable.

I cannot conscientiously advise every farmer to keep nothing but pure-bred poultry, but I would like to see every one without exception use at least pure-bred males of the breed that best suited their purpose. If the poultrymen of this country could be induced to do this, the sale of pure-bred poultry by breeders and fanciers would not only be ten times what it is to-day, but many would succeed where they now fail. Very often a fancier stands out against any teaching like this. They say keep pure-bred fowls, pure-bred males and females, have them all alike, and take pleasure in their beauty. Let those who want to follow the business of raising pure-breds do so; let them do the improving, and if it is practical buy your stock of them, whether you cross or breed pure. The man who raises ten acres of potatoes does not select the seed because it produces handsome blossoms. I believe that the mechanics and market producers, the majority, want to get what will give the best returns, regardless of anything else.

There is a legitimate field for fanciers who sell exhibition and breeding birds, but they have to be artists, as well as students of the laws of breeding. To make the business pay, they must be also skilful advertisers. Those of this class who succeed are few compared with the great number who can make money producing eggs and poultry for market. Skilful breeders, with only room enough to raise a few pure-bred fowls, like the painter on canvas, do best to produce a few choice artistic productions, that bring fancy prices; but the breeder who engages extensively, if he breeds

the stock demanded by practical producers, and is sufficiently well known, can sell all he can raise at a good price, and make the most money. The skilful fancier will have a great advantage if he is on a farm instead of a village lot. If I were going into the business to-day, to sell pure-bred breeding stock, I should follow either plan, according to circumstances, and I think I could make more money than by breeding poultry or eggs for market.

Every year there is more and more demand all over the country for pure-bred males to improve stock, and every year there will be a greater demand. I have a friend who sold eighteen hundred dollars' worth of pure-bred cockerels last season. There is a chance in this line, but not every one is cut out for the work. Others will do better to let the breeder improve and perfect, and regularly get their males from him. The male is the most important part of the flock. I am out of all patience with this idea of buying the meanest, cheapest specimen of pure-breds. Get the best, — not the exhibition birds, but those having in the greatest excellence the qualities you desire, and pay what you must to secure them. A good bird at from two to five dollars is a wise investment, even for grading up common stock or making crosses. If you reckon the difference it makes in the increase in egg-production alone, you will be convinced. The size and marketable qualities of the whole flock depend greatly upon the superiority or inferiority of the male.

Producers of cattle, sheep and hogs for market have found they usually get stronger animals and better market stock by producing first crosses and high grades. By using a male of the same breed year after year, we secure grades that are hardy and have the qualities of the pure breed. If males of different breeds are used each season, the stock soon becomes rather inferior. The more they are mixed in this way, the more breeds they are composed of, the worse they become. By crossing two pure breeds that are very dissimilar, we secure an increase in hardiness in the first cross, as well as the special qualities of each breed in a high degree. More of the chickens will live, and the feeding power is also greater. These first crosses, the males especially, should be marketed, never bred from.

Choice fowls that have been weakened by overfeeding, confinement and overshowing, that would not give satisfaction if bred pure, may sometimes be used with safety for crossing. Hardy stock that has been on the farm for five or six years is too good stock to throw away. I would advise no market raiser to discard it entirely, and depend upon pure-bred stock that he knew nothing about. I see that lately the Guernsey Cattle Club, instead of advocating that farmers keep nothing but pure-bred Guernsey, advocate the use of Guernsey grades, made by breeding Guernsey bulls with good cows,— that such are best for the ordinary farmer. One of the leading wealthy fancy farmers of New York State has recently imported a foreign breed of cattle to cross with his Jerseys, because he finds he can get better results than from the pure-bred cows.

It is well to remember that those who write and work only to sell their pure-bred stock are not perfectly disinterested. An exhibition bird, especially if of the nervous, active varieties, jaded by being sent around from show to show, and perhaps bred from stock managed the same, is not what a market poultry raiser should depend upon for his season's crop. He has not only been severely taxed, but during transportation has been exposed to various diseases.

I am a fancier as well as a student of the commercial end of the industry. I admire the beautiful in poultry. If I were to say what I feel about White Leghorns, I might make some people enthusiastic; but I have seen the disadvantages as well as the advantages of fancy stock for the farmer, therefore I give you this advice.

The Chairman. This subject is open for discussion, and I hope you will ask questions.

Mr. Dunbar (of West Bridgewater). Is it safe to feed gluten meal to young fowls?

Mr. Cushman. I do not hesitate to say I have fed very little gluten meal. Many of the best producers do feed gluten meal. I see a man right here who has fed a good deal of it, and will ask Mr. James Rankin to answer the question.

Mr. RANKIN. We feed gluten meal in our common ration. I should not care to feed it exclusively to very young chickens. It has a tendency to bring out a high color in the skin of the chicken.

QUESTION. What is the best and cheapest hen house for a farmer with one hundred hens?

Mr. CUSHMAN. For the specialist I suppose the long hen house with an aisle on the back is an excellent plan. My preference to lessen labor and risk is colony houses scattered about the place. I believe in larger flocks than a great many advocate if kept in that way. My preference would be to have two buildings for one hundred hens, and have it so they could range about the building. It would make a difference what breed was kept. If Rhode Island Reds, I should prefer two buildings, the simpler the better. A large poultryman whom I know spends about fifteen dollars on a house. He builds them not very tight, they are not shingled; the roofs are of boards, battened; there is a door on the south; no floor; filled to the sills with earth, to have it higher that the surrounding land. He keeps from twenty to forty hens in each house. He does not get the profit that a great many do who have yards. He has one hundred such houses on his place, and has conducted the business on that plan for a great many years, at least ten. The average farmer, I believe, will do best to follow that plan, rather than be obliged to do so much work every day. Most of the farm poultrymen I have seen neglect to attend to all the details.

A great many put too much glass into the houses. I think a house the longest from north to south, and facing the south with a glass in the south side, and an ordinary door, and the depth of the house extending back, so the fowls will roost in the back the greatest possible distance from the window and the door, is a very good house. I do not think if I were to build a house I would build dropping boards. Build the roosts in such a way that the droppings will fall on the floor. By putting a little board edgeways in front of the roosts and throwing dirt or plaster on the ground every little while, I believe you would be much better off than to have the dropping board under the roost.

If one will clean it off every day and put in fresh plaster, it is all right, but hardly one out of ten of the average poultry keepers would do it, and the flocks are, I believe, considerably injured in health.

QUESTION. If you keep fifty fowls, will they not do better twenty-five in a yard?

Mr. CUSHMAN. I think they will, but if they have full liberty I am not afraid of even forty in a house. Specialists in poultry keeping advise about ten or fifteen hens in a space ten by fifteen feet, and they claim that that number of fowls will give more eggs than double that number kept in the same space. But that applies to fowls kept in confinement, and where the quarters are restricted. On the farm I do not believe in that. I think if every farmer takes that scheme up he will make a mistake. I believe it is a mistake to kill the hens every year. I do not believe in having Brahmas two or three years old, and depend on them for laying, or Plymouth Rocks or Wyandottes either, if forced or kept confined. A three-year-old White Leghorn or a two-year-old Minorca is better than a pullet.

Mr. S. S. STETSON (of Lakeville). Is there a disease known as apoplexy? If so, the treatment?

Mr. CUSHMAN. I think fowls have a great many diseases that people have and that other animals have, and we have to exercise the same judgment in treating them that we would with animals. I think that trouble usually comes about from overfeeding or not enough exercise. Giving light feed, exercise and green grass is about as good a scheme as you can follow. Any fowl much out of sorts had better have its head cut off and be put under ground. If a hen once has any trouble there is always a tendency to have that trouble, and the chickens are liable to have the same trouble. If you buy a fowl that has had the roup, you may not see any signs of the disease in the chickens, but they will get the roup, while those whose ancestors have not had it will not have even colds. The hardiness of stock is one of the most important points of the whole business. Roup, according to my experience, comes from a cold that is neglected and does not get well. In most cases disease in

poultry comes from overfeeding and lack of exercise and lack of sanitary precautions.

Mr. STETSON. I raise Plymouth Rocks, and occasionally find one dead.

Mr. CUSHMAN. How do you feed them?

Mr. STETSON. On wheat and a mixture of shorts and other grains and a very little corn.

Mr. CUSHMAN. Three times a day?

Mr. STETSON. Twice a day, morning and night. They are confined somewhat, although they have quite an extensive range in a yard. They are in an orchard sheltered by trees.

Mr. CUSHMAN. In my opinion, these troubles come about from overfeeding more than from anything else. They get too fat and too sluggish, and like a person, have this trouble. Plenty of green food will prevent that condition as well as anything. Some breeds are more troubled by it than others.

Mr. F. W. SARGENT (of Amesbury). I would like to ask a question in regard to the Hamburg breed. I have had some trouble with the chicks this year. I saw a very pretty flock in my travels last spring, and, thinking they would please my boy, I bought a setting of eggs, and after carrying them a week in my travelling bag arrived home with them. He set them, and, very much to my surprise, they all hatched but one, but they did not seem to enjoy life. They started off well, but the wings got very much out of proportion. They grew faster than the body, and the chicks began to die, and we saved only three out of the lot. I know that breed quite often does that way. I would like to know if there is any way to prevent it. I would like to raise it, if I can.

Mr. CUSHMAN. Overfeeding will cause it. Feeding too much nitrogenous food will cause it. In incubator chickens, having the wings grow too long is one of the greatest troubles. The food that was given in this case would have to be considered, whether they had free range on grass or not. Sometimes getting wet in the morning will upset them and put them out of condition. Hamburgs are more tender than many other breeds.

Mr. Sargent. They were kept in equal circumstances with Brahmas and Plymouth Rocks, and we had no trouble with the others.

Mr. Crocker. Is sickness not owing more to breeding of lice than any other cause except the lack of brains?

Mr. Cushman. I think there are a great many poultry keepers who have sick fowls covered with lice. They do not realize that there are lice on the birds. I have been called many times to breeder houses where the keeper has had trouble with his fowls, and has done everything, but has not been able to help them. I have found these birds covered with lice. Many poultry keepers make a rule to treat their fowls with Persian insect powder regularly.

Overfeeding will cause bowel trouble, and there are lots of different things that will upset a chicken and cause that condition. One could determine the cause better by looking at the chickens than in any other way. I am always careful not to feed sloppy food, and to have everything clean, and always fresh water, and have the cups and dishes cleaned every day. Feeding too much will sometimes cause bowel trouble, or a little too much of a certain kind of food. I watch the droppings, and change the food as necessary.

Mr. Walton Hall (of Marshfield). In regard to laying hens, I would like to know the best possible breed for layers, how many to be kept in one flock, and the best building for their comfort.

Mr. Cushman. There are so many different buildings and so many different breeds I should hate to mislead anybody. A very good building is one about ten by fifteen feet, with an open shed attached of the same size. That is a most excellent building. The very best breed, in my opinion, for producing eggs the year around is the Black Minorca. If you want market poultry, you have to give that up. If you want brown eggs and a nice dressed fowl at the same time, the White Wyandotte cannot be beaten. I consider the White Wyandotte ahead of the Plymouth Rock. If you want market poultry to bring the highest price, you have to have a white or buff fowl. A house ten by fifteen with a ten by fifteen shed ought to keep fifteen or twenty fowls if they have range. You can keep a larger

number of Leghorns than you can Brahmas or White Wyandottes or Plymouth Rocks. Very active fowls can get so much exercise in the daytime that they can get along in smaller quarters at night, especially if they have an open house or open cracks on one side. I do not believe in close houses. Fowls can stand cold air all right. It is draughts they do not like. If you shut them up tight, they get tender and take cold easily. If you feed very hot messes it has the same effect. I do not believe in either. You get more eggs, but more risk. I like to get rid of all chance of disease that is possible, even if I do not get quite the profit.

The farmer I mentioned has one hundred houses and keeps three thousand fowls. They have just ordinary board houses, without any matched boards, but they batten the cracks on the sides, so there is no draught over them. Of course he is a little nearer the sea than this is. There is a man in New Hampshire who keeps three thousand in houses like a tent, and one end is open all winter. It is better to have them exposed to cold winter air than to have them shut up and not have all the air they want.

Mr. Hall. Would you let poultry go on the ground, whether there is any snow there or not?

Mr. Cushman. I think if there was a heavy snow I should let them stay in the house. I think, if you can dig five or six feet square in front of the house, it is very desirable. I do not like to have them on the snow. In New Hampshire they have snow so that the hens have to stay in weeks at a time.

Question. Would the shed houses be better than houses in the side of a hill?

Mr. Cushman. If you can keep them from getting damp, such houses are very good. I have seen a great many fowls kept in that way, and I think they lay better if partly underground in the coldest weather, if it is perfectly dry, than they do above ground. I think you get more eggs when eggs are highest if partly underground. But if water is going to come in and wet the floor, and you keep Leghorns, you are going to get into trouble.

Mr. ——. I know a poultryman who builds cheap houses

for summer, costing three dollars each. They are arranged so two men can move them to any desired location.

Mr. Cushman. I think that is a good plan. Each man has to have a little different arrangement. I do not believe in advising every one to do the same thing. There is a great deal to do, and people who think they can go into it without studying it at all are going to make mistakes with the competition we have now. Out west they are buying pure-bred poultry, raising stock from it and shipping it east and the farmers here who are not up to date are getting as low prices for what they raise here as that raised on cheap grain in the west. How can they keep it up? We can get the gilt-edge prices only by having something better than the western product, by having the eggs turned into Boston market twelve hours old, as Mr. Collingwood said in regard to strawberries.

Mr. Griffin (of Brockton). I have had several people come to me and ask my advice about roup, and I always tell them I think it is cheaper to dispose of the fowl. They will say the fowls cost them a big price. I would like to know if your advice would be to kill these fowls.

Mr. Cushman. When I bred white Leghorns and got fifteen dollars for some of them, I hated to do it. A little trouble along the roup line may be cured, but if it hangs along it will go all through the fowl and injure it so that it will never be as good again.

Mr. Griffin. What would be the best cure?

Mr. Cushman. The first thing I would disinfect the nostrils with some solution like carbolic acid and water or carbolic acid and sweet oil to kill the germs; then treat with something that is astringent, to check the discharge and enable the fowl to get over the cold. A good many use quinine pills, the same as for themselves, but do not give as large a dose.

It is hard work to overfeed a Leghorn at liberty. I have had one or two hundred in the winter taken with the roup. I do not want any more. By careful prevention you can get along all right with most anything. After you have once got the roup into a flock, it is likely to go through them all. If every one would take away and kill and bury

the first sick fowl, it would save a great deal of trouble. A roupy fowl will give it to other fowls, if they drink from the same receptacle. A vigorous, healthy fowl is not likely to catch disease, but a weakened one will, the same as with people and animals.

Mr. TURNER (of Dighton). Is it profitable to feed wheat to fall chickens or laying hens at the present price?

Mr. CUSHMAN. I should feed a little wheat. I believe it is a most excellent egg-producer. We can feed gluten and beef scraps to take the place of wheat. Wheat bran, beef scraps, gluten and corn meal will enable any one to get along without much wheat.

Mr. TURNER. How would you feed clover?

Mr. CUSHMAN. I believe in feeding it growing on the ground. One can cut up cured clover and mix it with the soft mess, but the latter should not be too soft. My experience has been that this is the best method. Cut fine and fed soaked or dry it is very acceptable.

Mr. KING. I would like to hear something about the good qualities of the Rhode Island Red.

Mr. CUSHMAN. It has not been bred for exhibition. It is a buff fowl, probably originated from the old Cochin-Chinas, some of the Leghorn varieties being crossed in and perhaps a little Game. They are unusually hardy and vigorous, and are hustlers. They have yellow legs and flesh, and when dressed make very good table poultry. Being a buff breed, they dress about as well as if white. They are a most excellent fowl. The egg is light brown, about like the Wyandotte. The three-year-old hens lay the largest eggs for their size of anything I know of.

Mr. KING. Is it large, or small?

Mr. CUSHMAN. It is a little larger than the Leghorn, but more stocky. It is nearer the Wyandotte than almost anything else. The buff Plymouth Rock and buff Wyandotte are made from the Rhode Island Red. I should rather to-day, if I were going into the farm poultry business, have a stock of Rhode Island Reds to grade up on than anything else I know of, because they are so hardy.

There is a gentleman here who has been breeding a breed of hens very much like the Rhode Island Reds, that

are hardy, and I think they have qualities that are better. I refer to Mr. B——. Perhaps he can tell something about it.

Mr. B——. The fowl is the Golden Sundown. It is bred in this way: I take a light Brahma, Plymouth Rock, Brown Leghorn and the Game. I have been breeding them for thirteen years. They are good layers, are hardy and a good table fowl. I came to the conclusion that I could get a breed by a combination of the four best breeds I knew of. I thought I could bring out what I have brought out.

Mr. W. B. Barton (of Dalton). We have Dr. Twitchell with us, and I would like to hear from him.

Dr. Twitchell. Somehow, Mr. Chairman, ladies and gentlemen, when I get into an audience where I find as many "hen" men as there are here to-day I feel as I suppose a good Methodist does when he gets into a good warm camp meeting, — very much at home. I have thoroughly enjoyed the valuable suggestions presented to us by the speaker this afternoon. I enjoy the discussion which follows, and the questions which are presented from the audience. This poultry industry is a many-sided industry. They tell the story down in Maine of a Sunday-school teacher who numbered the questions in a catechism and gave each boy in her class one question, and told them to prepare themselves to answer the questions at the concert. They learned the answers, and when the time came for the concert she got the children on the platform, and did not notice that boy Number 1 was missing. She said, "Johnnie, who made you?" Nobody answered. She repeated the question, and boy Number 2 said, "Please marm, I was made out of the dust of the earth. The boy that God made had a stomach-ache and could not come." We are apt to think we can answer one question only in this industry. We look at one side of the picture and see it from our own point of view. I thought of that as we have been discussing this question. The questions would indicate to me the fact that the questioner favors some one breed. The breeds are just what men make them. We have taken them and built on them, and out of them in the years have come the many breeds which are to-day so

valuable to us, and from which we can select the ones best suited to us, as the speaker so well said. I do not believe a farmer can take a Rhode Island Red and a Plymouth Rock and be equally successful. We should carry in our minds continually the method in which they came, — the thought of the men who have been behind the making of these birds, the type which they represent. Mr. Cushman hinted at that when he spoke of the beef type. I am going to put against that the dairy type. You can trace it down through the whole animal kingdom. I do not know but it is so with man. When you find a producing animal, one always giving out, you find the dairy type. When you find the type that gathers in and stores up for its own benefit, it is the beef type. Divide on that general line, then sub-divide according to your fancy, and you have the breed best adapted to you. First a variation, then a tendency, then a habit; when we get a habit we have fixed the type. It is the man behind the breed always which fixes the type. I do not believe every man is expected to be a successful hen breeder. It takes a great deal of a man to be a successful "hen" man. There is only one James Rankin on this continent. He is a marked illustration of what man has been doing and can continually do. I mention this because he has stimulated others, and his influence is felt where he has never been seen, because of his daily experience, his investigations and the results which he has obtained, and the whole thing has hinged upon his appreciation of the duck. A man who appreciates a duck has got to be quite a man, I assure you. If my wife were here, she would tell a story; I am glad she is not here.

In regard to roup, the killing of the first hen, the prevention of the first symptom of disease, is the only absolute cure. Down in Maine we cannot have open barns. I have already seen the thermometer fifteen degrees below zero this year, and an open shed would be hardly the thing to keep poultry in.

I was glad to hear Mr. Cushman emphasize colonizing.

In reference to the matter of adaptation: John Randolph would go half a mile to kick a sheep. He never would be successful in raising young lambs for Boston market. There

was an old lady of whom we tell the story in Maine who borrowed a setting hen and went to another neighbor and borrowed a dozen of eggs. She put them together, and in due time the chickens appeared. After a few weeks the hen weaned the chickens and the old lady kept the hen until she had laid a dozen eggs, then returned the borrowed eggs and carried back the hen and had the chickens left. That woman will make a success in the hen business. That is what I mean by adaptation. It makes but little difference what breed you take. Having in your mind a distinct type, make your selection of breeds and build for type, making color and fancy markings secondary. I believe, and have urged it many times, what Mr. Cushman has said about selecting hens from your flocks and using a pure-bred male. I believe this is the course to be pursued, unless you desire to enter the field of the specialist, — take what you have and build upon it. When you have made your first cross, then year after year lift that cross by using a male of the same breed until you have established your breed.

Secretary SESSIONS. You would not object to the Rhode Island Red for that?

Dr. TWITCHELL. I would not object to any breed fixed by this method in its characteristics. I would not object to your going into your flock and selecting your best hens for 1898, and then buying a male of the same type, using ever after a pure-bred male of the same breed.

I have in mind a friend in the State of Maine who keeps about eleven hundred hens. It is eighteen years since I first started him in business. He raises three thousand chickens yearly. They are hatched by hens and raised in barrels. His farm and buildings would not sell for twenty-five hundred dollars. He is twelve miles from a shipping town on the extreme eastern coast of the State of Maine. And yet that man has realized a net profit of one dollar and twenty-five cents per head per hen yearly. He has Barred Plymouth Rocks, and has bred them all these years, simply introducing new blood. He has taken what he could get for poultry, eggs being the central thought.

I have another friend who carries about a thousand hens. His buildings are about twelve by twenty feet, and set so

the hens can get to the ground underneath, but has a second floor with room enough for him to pass through himself. He carries about fifty hens to the building. The buildings are set about fifty rods apart. The hens mix in the daytime, but are home at night and in their pens. That man has realized a net income from that flock of more than a thousand dollars a year for his labor. He has not Boston or Taunton market at hand. His product has to be shipped two hundred miles. The other gentleman has to ship by boat from Eastport. There is no industry in my knowledge where there is such an opportunity to-day for the man or woman who has a liking for it to realize as much on the expenditure as in the making of eggs and poultry.

Mr. CUSHMAN. What is your experience in regard to killing hens the first, second or third year?

Dr. TWITCHELL. My impression is that there is more money in killing birds when about fifteen months old and selling them for spring chickens than in keeping them longer. There is always a time, between hay and grass, when things are in demand, and chickens that are hatched in March or the first of April will go through the year and finish their laying about the next June, and if they are fed for business, and are not fat, will sell very close to chicken prices. This has been my experience, and I am always ready to take the chicken prices. I do not question that hens can be profitably kept three or four years. Something depends on the breed.

Mr. JAMES RANKIN. I confess feeling a little hurt. I cannot understand why my name is always associated with that of the duck. I do not want these people to understand that I raise only ducks. I raise hens, — all kinds of them. I have crossed and recrossed them for some time, and I find that there is nothing that will respond to kind and gentle treatment sooner than a hen. After the war I sold chickens for fifty cents a pound. My neighbors went into the business, and cut the prices down. Then I branched off onto ducks. When they commence raising ducks, I do not know what I shall do unless I take turkeys.

To go back to poultry raising, I will endorse what the gentleman has said, — there is no farm product that will

make such bountiful returns as poultry. You can turn it every three months. It is a cash product, a concentrated product. I can grow a pound of chicken or duck just as cheaply as I can grow a pound of beef or pork, and a little cheaper, and it will command three times as much on the market. We grow a surplus of wheat and corn, but we do not grow enough poultry for home use. We import large quantities of eggs from Sweden. We ship corn to Europe, and they return it to us in eggs.

In regard to the number of fowls to be kept in one building, I think Mr. Cushman went hardly far enough. If one is an amateur, a pair of fowls is all that he should be entrusted with; if he is an expert, he can easily keep fifty in one building. I do not like the word "disinfectant." They should be kept clean enough without disinfecting.

QUESTION. Are not Black Leghorns a good fowl? Are they not hardier than the White Leghorns?

Mr. CUSHMAN. I think any black fowl is hardier than a white fowl, other conditions being equal. The only reason I prefer White Leghorns to any other Leghorn is that a yellow-legged fowl will sell best in market. For myself, I had just as soon have a black-legged fowl to eat, if it is plump. We do not know but the market will change, and call for black-legged fowls. The Black Leghorn will lay more eggs, but smaller, than the Black Minorca. A Leghorn does not amount to much when you kill it. If one eats his own fowls, it does not matter what the market calls for. But if fowls are raised for the market we have to change as the market changes, no matter how unreasonable the fancies and fads are. I do not believe there is a man living who knows all the good and all the bad qualities of all the different breeds. They will act differently in different climates. I would not say I could describe six breeds, and not be wrong. I bred White Leghorns for ten years for exhibition, and perhaps I am a little in favor of White Leghorns, for that reason. I think the Black Leghorn is hardier than the White Leghorn.

Secretary SESSIONS. The president of the Massachusetts Fruit Growers' Association requests me to state that there will be a meeting of the directors of the association to-

morrow morning at the hotel at 8 o'clock. The time of the banquet this evening will be as nearly 7 o'clock as possible.

Adjourned at 4 P.M.

On Wednesday evening a banquet was given the State Board of Agriculture in Odd Fellows' Hall by the Taunton Board of Trade. After the banquet speeches were made by General Curtis Guild, Jr., representing the Commonwealth, Dr. Geo. M. Twitchell of Maine, Hon. T. S. Gold of Connecticut, Mr. Walter F. Taber of New York, Mr. H. W. Collingwood of New Jersey and Messrs. E. W. Wood, Hall, Ellsworth and Sessions of the State Board of Agriculture. Judge Hall of Taunton ably filled the position of toast master. The occasion was well planned and was thoroughly enjoyed.

THIRD DAY.

The meeting was called to order at 10.15 A.M. by Secretary SESSIONS, who said: Mr. E. W. WOOD, vice-president of the Board, a man as well posted on fruit as any member of the Board, will preside at this meeting. The members of the Board feel that they will be honored and favored by the presence of our chosen vice-president in the chair. He has very modestly and courteously avoided presiding heretofore, and has named various gentlemen to fill the chair, and they have all done well; but we depend on the "war-horse" this morning.

The CHAIRMAN. Gentlemen: The committee has selected for this forenoon's discussion a subject which, perhaps, is the most interesting question to the horticulturists of this section. While we have good growers of the strawberry in many parts of the State, while we may claim to grow as good fruits of that kind as any State in the Union, it still is desirable to rub up against men from other portions of the country. They may have some new method, as they are constantly changing, that would be of benefit to the practical growers in this vicinity; and your committee has invited a man of large experience in the growing of small fruits, and a practical man, to address you this morning on the subject of small fruits. I have the pleasure of introducing to you Mr. W. F. TABER, president of the Eastern New York Horticultural Society, who will address you on that subject.

Mr. TABER. Ladies and gentlemen: As I looked out this morning and saw the sun shining over the eastern hills, I thought of the contrast and of the changes which had taken place since, about one hundred and fifty years ago, the Quakers, of whom I am a representative, were driven out of Massachusetts to take refuge where my ancestors took refuge, —in the State of New York. Received as I have been in this community, there certainly is a great change. Perhaps it is partly due to my ancestors having located upon land adjoining the Connecticut line and my having received an education partly in Litchfield. I have also taught school in Connecticut. There is no line that divides us. We are brethren. We meet here this morning to discuss a subject

full of interest, and becoming more and more of interest as we grow older. I am aware that I am talking to men who have been in this business longer than I, and when your secretary invited me to come before you and talk on this subject, I was at a loss to decide as to what I could say upon it.

As the manuscript is required for the use of the Board of Agriculture, you will pardon me if I read from the notes I have made.

Raising and Marketing of Fruit.

BY WALTER F. TABER, POUGHKEEPSIE, N. Y.

Mr. Chairman, ladies and gentlemen: The subject upon which I have been requested to address you, although it pertains principally to *small fruits*, is no *small* subject.

The business of fruit growing has attained to magnificent proportions. Fruit by the car load is more common than was fruit by the wagon load and I may say by the back load in my boyhood days, for the fruit then was like Topsy, — "it just growed."

The command given to Adam to dress and keep the garden was in those days but poorly obeyed, but it holds good and is applicable to every student of horticulture at the present time. Truly speaking, man cannot *grow* fruit, but a Power beyond the power of man is necessary to carry forward all the changes from bud to leaf, from flower to fruit: —

> To paint the leaf in living green,
> The blush on tiny blossom seen,
> The roseate tint, the crimson hue
> That's painted by the Master's hand, —
> Man does not, cannot e'er command.

How has he done this? By selection, by hybridization, by fertilization and proper cultivation, and in later years by intelligent care and vigorous application of every known remedy to repel and destroy insect life and fungous growths that seem to multiply with each succeeding year.

This subject is so broad and so much has been said and written that it seems almost superfluous for me to attempt to say anything new or instructive upon fruit growing; but, as I scan the pages of our horticultural and agricultural papers, I find recorded there the methods pursued and the

results obtained in their various experiments in fruit culture of persons in different sections of our country, and so varied are these that the thought arises that possibly I may shed some light upon the otherwise unknown causes of failure in securing adequate compensation for the labor expended in the production of crops.

I have found that the only way I could determine the value of any particular kind of fruit, to me, was to grow it on my own soil, as there seems to be many kinds that are like some people, very particular, and even fail to respond to good treatment. I am successful in growing some kinds of fruit that cannot be grown two miles away because of difference in soil.

Believing that successful experimenting teaches a better lesson than any theory that may be presented, I trust you will not think me egotistical if I draw from the records of my own experience some results in confirmation of what I may say in the further consideration of this subject.

The three great essentials that underlie the successful growing of fruit are: character and fertility of soil, selection of varieties, and proper cultivation.

Just as sure as it is necessary to build a good foundation under a house in order to insure its safety and permanence, just so sure will it pay to prepare the soil in the very best manner by fertilization and deep and thorough pulverization before setting our plants or trees. My experience has shown me that we do not work our soils deep enough nor often enough for best results; and this view is borne out by the experiments of others, notably Professor Roberts of Cornell University, who, on fairly good land, as he tells us, without manure, increased the yield of potatoes thirty bushels per acre by two extra cultivations and sixty bushels by four extra cultivations. This was on gravelly soil, sixty per cent sand, which was not retentive of moisture, but had plenty of the mineral elements. This was in 1896. Again, the past season, 1897, he has obtained three hundred bushels per acre from this same land by cultivating seven times, and ninety per cent of the crop was marketable. Contrast this with results in a neighboring field, where but one hundred bushels were grown, fifty per cent being marketable.

The second of these essentials is the selection of varieties. They must be selected with due regard to adaptation of soil, the demands of the particular market where the fruit will be sold, and the location of the individual grower.

The person who can place his fruit upon the market or in the dealers' hands without the aid of transportation companies or commission men has superior advantages, not only in saving to himself these charges and commissions, but he can grow and place upon the market in fine condition many very attractive fruits that will not be salable when subjected to the handling that our fruits often receive.

The subject of proper cultivation I will treat further on, as I want here to call your attention to the formative elements of earth, air and water, and recognize the essential importance of each as pertaining to the growth of plants.

We recognize the fact that the virgin soil responds to the cultivator's art and rewards the toil of the husbandman. Why? Because every element necessary for plant growth is stored up within it. The chemist has resolved these elements into the three forms of potash, phosphoric acid and nitrogen, ignoring some of the baser but no less indispensable elements that enter into the composition of plants or form the medium through which the activities of these three most essential elements are brought into a condition necessary for plant growth.

Go with me to yonder forest, and note the luxuriant foliage and healthy growth of those stately trees. What is it that supports them? I answer *water* and *humus*. By the aid of decaying leaves and wood a reservoir is formed to hold the moisture in the soil, to dissolve its mineral elements for its material growth, while the millions of open mouths that their leaves present absorb the dews from heaven and the free nitrogen of the air. Herein we see the operation of the laws of nature, and the cultivator is wise who takes note of these and conforms his methods in accordance with them.

What is it that causes our hillsides and valleys in the wooded sections of our country to be clothed in living green? *Water*. What is it that makes our broad plains arid? The absence of water. Water, then, is the synonym

for life. Without it death comes to every living thing, be it animate or inanimate. No man of ordinary intelligence but knows enough of the methods in the laboratory of nature to understand that all plant food must be rendered soluble before it can be assimilated by the plant; therefore all fertilizers of every name and nature are dependent upon water to render them available. Therefore the first thought of the cultivator of the soil should be, *How best can I secure* the necessary moisture to enable the plant to fulfil its mission?

I am not here to-day to explain to you how this may be done by some system of irrigation, although I believe that the day is not far distant when our streams and lakes shall be made to minister to the needs of the growing plant. In proof of my faith in this I put in an irrigation plant last spring, a fourteen horse-power gasoline engine (New Era), and a rotary pump capable of pumping three hundred gallons per minute, but the season was such that it was not needed. In fact, some of my strawberry grounds were flooded at times; and just here comes in one of the advantages secured by the system which I shall proceed to show you as one of the ways, and one available to every man who tills the soil, of conserving and retaining the moisture in it for the uses of the plant.

Let us consider for a few moments the character of very much of the soil that we see in travelling over the country. Is it not a recognized fact that very much of it is compact and hard? A compact soil is necessarily a dry one. Water may fall upon it, but it will not be absorbed because of the lack of vegetable matter, humus, to render it porous by being incorporated with the soil by proper cultivation, which must be done before it can be made productive.

Humus or vegetable matter thus becomes the key that unlocks the resources of nature and enables that other element, the air, to permeate the soil and deposit its moisture, starting into activity what Professor Roberts so aptly terms "our invisible friends," the microbes, and acting upon the mineral elements renders them soluble and food for plants. The amount of moisture stored up in this way must depend upon the depth of soil that is rendered porous

and permeable to the atmosphere, and the finer the soil is made the more moisture it will retain.

My experience has led me to deepen my cultivation until most of my land, a slaty clay soil, has been worked twelve inches in depth. This serves a double purpose, especially upon nearly level land: first, by storing up the moisture for plant growth; and, second, in times of heavy rainfall to absorb large quantities and to quickly carry away the surplus, by its capacity for drainage, from the roots of small plants that might otherwise suffer from the excessive supply.

I have one field that when first purchased destroyed one crop by drought and another by flooding, which is now able to withstand both these elements because of deep cultivation and the incorporation into it of large quantities of vegetable matter.

How can we best and most cheaply supply this vegetable matter to the soil? In my experience, it has been by ploughing under in a green state such crops as clover, oats and peas, rye and buckwheat, as time and opportunity offer. Clover undoubtedly stands at the head, because of its ability to go down deep into the soil and bring up fertility from below, and also to store up the free nitrogen of the air through the germ life that works upon the roots of the plant. Crimson clover, wherever it can be grown, is one of the most active agencies in restoring fertility to the soil. I have received much benefit from it, and would recommend it in vineyard and orchard culture as a cover crop during the winter and for its effects upon the soil, as will be shown later on.

I have had excellent results from ploughing under heavy crops of both clover and rye during the three dry seasons previous to the last. About the 1st of June, 1894, I ploughed under a heavy growth of clover, rolled the ground and planted to sweet corn. No rain of any account fell upon it after planting. The corn started slowly, but when its roots got hold of the decomposing vegetable matter its growth was very rapid, and more luxuriant, healthy growth you never saw, and the outcome was a crop that paid me over one hundred dollars per acre. The same season I had a field of rye as thick as it could stand and eighteen inches

in height ploughed under one foot deep, and the land rolled and thoroughly compacted, as it was a loose black soil, the particles being round like shot and becoming entirely destitute of moisture under a hot sun. This was set to strawberries. A few showers set them into growing, after which, from about the middle of June to the 1st of September, no rain fell on them. On September 1 each plant set had sent out runners upon which had grown from fifteen to twenty-five as strong, healthy plants as you ever saw, but *not a root on them*, as this black soil to the depth of two or three inches was as dry as dust. These plants were sustained by the parent plant drawing up moisture from the decomposing mass of rye that was ploughed under. In two weeks from the time the first rain came upon them they were all rooted, showing the *efficacy and power of water*.

Pardon me if I have dwelt too long upon this part of the subject, the preparation of the soil, for I deem it of great importance. Now, having prepared our soil properly, we can proceed to plant with a consciousness of duty done; and as we walk by faith with the star of hope to guide, let us take up the work as the season opens upon us.

The currant and the raspberry are the first to start in the spring. I therefore recommend to plant these in the fall, the currant in hills five feet each way, the raspberry in rows five feet apart and three feet in the row. No pruning or trimming is required the first year. Set stakes to raspberries, and in the following spring cut out old canes and thin plants to four or five in a hill after the first year. Keep currant bushes upright and thin, leaving no wood more than three years old to bear fruit. The perfect red raspberry is not in sight, unless it be some sort not yet fully tried. I succeed very well with the Marlboro, but I know of many who do not succeed. Miller's Red has not done well with me except in growing plants. I am favorably impressed with the Loudon, but have not fruited them in sufficient quantity to judge. The plant is very strong and healthy. The Royal Church is a good table berry, but crumbles easily and is too soft for market. The Columbian is a great grower and producer, but I cannot sell it: it is too dark for my market.

Black Caps I set in the spring, five feet by three feet. After trying various methods of training, we now use posts and two wires, one each side of the row, which are stapled to posts set along the row at intervals of fifty feet, then bring the wires together every ten feet and tie. No tying of canes is necessary. You who have not seen this system tried may think it is a great deal of work, and I thought it would be when I first concluded to try it. But we found we could do the work a great deal quicker than we could tie the canes to the wires, and when they were once there they were safe. They would not fall down. We use No. 11 grape wire. I have found the Souhegan the most productive early black cap, and I prefer the Nemaha to the Gregg for late, although I am growing both.

Blackberries must next be attended to, as they start early. I have the Erie, the Minnewaska and the Eldorado, but have not fruited the latter. I have formerly grown others. I set them in rows eight feet apart and three feet in the row. I prefer setting posts and stretching a wire on each side of the row, stapling to the posts and tying the wires together the same as with black caps. There is then no tying of canes and no falling or blowing down. Top the shoots when about three feet high, and keep cut back so you can pick the fruit. Keep the space between the rows clear. Be boss all the time, or they will boss you.

There is a seedling of the Lawton that is better than the Lawton. It is found down in the lower part of Westchester County of my State. The Snyder is a good, sweet berry, and is perfectly hardy. You can rely on that, but there are two troubles with it. After the first few pickings, especially if the weather is dry, it becomes too small to sell, and it will turn brown very soon after being picked. That is the worst feature of it. You must fertilize that berry and treat it first-rate if you want to get a good berry. I have not grown the Agawam. I had not thought it superior to others, and I do not want too many varieties. It is said to be much sweeter than the Snyder.

We now come to the time to prepare the soil for the planting of small fruits, and as only last week I had an inquiry to answer through the columns of the "Rural New

Yorker," coming from a subscriber in this State, as to what were the best tools to use in the cultivation of raspberries and blackberries, I have thought that perhaps it would be proper to state what tools I use and have found best suited for the work in growing fruit.

A few days ago there came to me a notice of a proposed publication entitled "Fifty years' improvements in farming," and my memory recalled the wrestling feats I and the old plough had more than fifty years ago; and as I look adown the years and see the changes wrought, sometimes for the better and sometimes not, I see the soft iron changed to adamant and that supplemented by the steel, and last with wheels and pole man sits astride with power to hold and guide.

After using all the other kinds of ploughs, I have been obliged to buy and use a reversible sulky plough in order to have the work done as I wanted it done, in order to lay the foundation for the after-culture that I consider necessary. This plough, when properly used, takes precedence of any and all other tools. With this plough I can loosen the soil to the depth of twelve inches or more, and, if in proper condition, pulverize it as no other plough can. It lifts the furrow and turns it from the mould board, the under edge of which pulverizes the surface as no other plough can. It avoids making dead furrows and the tramping of the ploughed ground in turning. I hesitate to tell you what I have seen it do. My son was ploughing corn stubble for setting black caps. I took measurements of depth of furrow, which was twelve inches. This same furrow, when left by the plough, was eighteen inches in depth. One great advantage in its use is that, whether the ground be mellow or hard, it cuts an even depth of furrow, and, being very high under the beam, it does not clog in turning under strawy manure or green crops. I use with this plough fourteen-inch rolling steel coulters.

The next implement in order is the Cutaway harrow. This will cut and turn the soil from four to six inches in depth, and, unlike any other harrow, it covers *under* instead of bringing to the surface coarse material. I next use a sec-

tional all-steel harrow, with lever, so it can be adjusted to use as a spike tooth or smoothing harrow.

To complete the work, I use the planker. This I made of two-inch white oak plank, ten inches wide and eight feet long. Lap the planks two and one-half inches, and bolt with one-half inch bolts at each end and in the middle. Use five or six of the plank. Attach a bail wire or chain in two places on the front, and draw diagonal enough to prevent clogging. Either weight with stone or ride it. I prefer the planker to the roller. The roller compresses the land just as it finds it; but this planker fills the holes, makes it level, presses the stone into the soil and leaves a fine mulch on the surface. You will see that I use the plough. I believe in keeping the roots of all plants down in the ground, where they will have moisture. One of the difficulties in mulching is that you bring the roots of the plants to the surface, and if they are subjected to the action of drought they are affected very much sooner.

For cultivation of my vineyard I use the No. 5 vineyard plough, with adjustable beam and handles. This is also used in the spring between rows of blackberries, raspberries, currants and other small bushes or trees. I have four kinds of cultivators. The common five-tooth, with shovel teeth, winged thistle teeth and the long-winged coverers, used in hilling, is good for heavy work, where you need to break up the soil. The next is the spring tooth, very serviceable after ploughing between the berry and grape rows to level and make the soil fine. It is a general-purpose cultivator, but for cultivating between rows of newly set plants I use the twelve-tooth Planet Junior and the fourteen-tooth Iron Age. With these you can work very close to the plants without covering them or disturbing their roots. After the plants have rooted somewhat I use the Breed's Weeder to break the crust over the entire surface.

Though not absolutely essential, I find the Mackenny fertilizer sower, made in this State, a very great aid in fertilizing rows or drills. The Kemp manure spreader is a valuable aid in broad-casting manure and in covering strawberry rows with a manure mulch for winter protection.

Now, having ploughed, harrowed, smoothed and compacted the ground, we will make ready for the planting of the queen of fruits, — the strawberry. I mark my ground with a corn marker with rows four feet apart, and, with a fertilizer sower sowing two rows at a time, I distribute the fertilizer in beds two feet wide, leaving two feet between unfertilized. I now harrow and plank it again. If the work is well done, the ground will be as smooth as a board floor, and the dust mulch which it now has on the surface will prevent evaporation of moisture. In this compacted soil you may set your plants with an almost certainty of their living. I have found no way of setting strawberry plants as satisfactory as with a line and garden trowel.

I assume that the question of varieties to plant has been settled, and the plants are at hand. In deciding this question, location and nearness to market play an important part. Those who can deliver their fruit to the dealer or consumer can meet their tastes and demands by proper selection of varieties. The markets are calling for large, showy berries, and quality is being sacrificed to size and beauty. Then grow the big berries if your land is adapted to them; but, if you must ship your berries by railroad or boat, then firmness is the dominant quality, for they are sometimes subjected to rough usage and positive abuse at the hands of transportation companies and truckmen.

There is no strawberry with which I am acquainted that when grown as it grows with me presents so many desirable qualities of form, size, color, flavor and keeping and shipping qualities as Gandy's Prize. I sent a crate of them to the World's Fair at Chicago, and every berry went on the plates and remained on exhibition for nine days. And yet it is fickle and peculiar in its likes and dislikes. Many of the best fruit growers in the Hudson valley cannot make it profitable, being unproductive on their soil. The same may be said of the famous Marshall from this State. It succeeds splendidly in some places, but is worthless in other places. I saw Mr. J. H. Hale's trial beds of forty-three varieties on June 15 last, and the sixteen hills of the Marshall did not have as much fruit on them as one hill should have, while beside it were varieties heavily loaded, and in the field it

was badly rusted. I hope it may do better with me, as it has made a strong, healthy growth.

I set four thousand plants of the Brandywine in May, 1896. They surpassed all others in vigor of plant growth and clean, healthy foliage. There were taken from these rows last spring more than forty thousand plants. The first berries that ripened were splendid in size, color and quality, but later they were smaller, owing, I believe, to there being too many plants in the beds. I shall have an opportunity another season of testing it under different conditions, as I have the one-half acre of old beds, one-half acre set last spring and one-half acre in hills transplanted in August.

I fruited the Rio last season, a handsome early berry of good quality. It blossomed profusely, but frost lessened the production, so I could not judge it fairly. The Noble and the Eleanor I found of fine form and color, of superior flavor and excellent for the home garden. The Eureka, Sunrise, Sunnyside and Leader have nothing to commend them above the Bubach, Greenville, Jesse and others of the older varieties. I have growing, but have not fruited, the Clyde, Bismarck, Glen-Mary, Hunn and Michigan. I plant five or six of the new varieties each year that are so highly extolled in the catalogues, and *sometimes* get *one* or *two* good enough to keep.

Now, assuming that the plants are set, start the twelve-tooth cultivator, and as soon as the roots have taken hold of the soil, the weeder, loosening only the surface soil and killing the weeds before they grow. As some kinds are such plant makers that the row is likely to be too wide, fasten two rolling-wheel coulters to the wings of a five-tooth cultivator, set it the proper width, add weight sufficient to make the coulters penetrate the ground three or four inches, drive between the rows and cut the runners and bury the ends. After the ground freezes, cover to keep the frost in and protect against sudden changes. I use short, strawy horse manure from the city stables, and apply evenly with a Kemp manure spreader, the back part being contracted to deliver it about three feet wide.

Much is being said and written about cultural methods, particularly for the strawberry. Statements are published

of enormous yields, but the most surprising statement is that a crop of strawberries can be produced as cheaply as any farm crop, not even excepting ruta-bagas. The same person tells us that potash and bone and ammonia as found outside of stable manure are *burning manures*, that burn the roots of our plants and fail to make them grow. From the same source I learn that ashes are *almost pure potash*. I think there are many fruit growers here that would like to know where they could buy such ashes, or even those that would analyze ten per cent potash, and take all the chances of burning up their crops. Maybe it is for want of all this knowledge that I have continued growing most of my fruits with commercial fertilizers in years past. This I have done because I have found it cheaper to use them than to buy stable manure.

I do not think I can bring an acre of strawberries up to picking time for less than $100 per acre on my soil, and expect to get paying returns. The best results were in 1893, when the sales from four and one-half acres of strawberries amounted to $2,378, over $530 per acre, besides what were consumed by the family. I received last year, 1896, from one acre of blackberries, $420; from five-eighths of an acre of Souhegan black caps, $427; and from one acre of Marlboro raspberries, $350.

I always plant in the spring, excepting currants and red raspberries, which I prefer to plant in the fall; and have never had returns sufficient from summer or fall set strawberries to pay for the extra labor involved, except by cutting a shovelful from the row that has borne a crop, and set in hills in furrows freshly prepared in moist soil.

The grape next claims our attention; and I have been something of a pioneer and maybe a crank in advocating certain ways of pruning and training the vine. I first trained the vine on what is termed the Kniffen system, four arms to the vine on a trellis of two wires three to six feet from the ground. I observed that the best fruit grew upon the upper arms, and the older the vine the greater the difference in size, lustre and value of the fruit. I removed the lower arms and lengthened the upper, with the result of producing larger clusters of better quality, and consequently

increased market value and in sufficient quantity. Another advance was made in removing the old arm, with its three or four bearing shoots with three or four buds on each, and leaving in its place one single bearing cane, starting from near the head of the vine with ten or twelve buds upon it. This system distributes the new growth along the vine, and when properly summer pruned gives the best possible chance for the growth of large, perfect clusters of fruit. There are other advantages resulting from this system, such as ease of pruning and spraying and of gathering the fruit; also, the free circulation of the air under the vines is conducive to healthy growth and freedom from mildew and rot.

My manner of fertilizing the vineyard is to grow crimson clover to provide humus and nitrogen, and to apply about eight hundred pounds of potash and bone per acre, in the proportion of one of the former to two of the latter. I believe the application of such fertilizers produces a sweeter and better quality of fruit than where stable manures are used.

Experiments in girdling the vine have been conducted in my vineyard for two years past, at the request of the New York State Experiment Station at Geneva. It is practised quite extensively in many vineyards in the Hudson valley; but I have always in my State institute work condemned the practice as a fraud upon the consumer and a damage to the vine. Our experiments confirm these opinions. Two Niagara vines girdled back to the renewal arm were killed by the operation. The grapes from girdled vines are larger and color earlier, *but are not ripe*, but, being colored, are sent to market to disgust the consumer and demoralize the trade.

Besides the insect enemies and fungous growths common to the vine, we have been beset by the larva of the saw-fly, which has proved very destructive, eating the leaves and denuding the vine as rapidly as the currant worm does the currant bush, and no remedy has been found to destroy it that did not also destroy the leaves.

Before passing from the small fruits, I want to say a word for the gooseberry. I have the Industry, Red Jacket and Whitesmith. I believe the time is coming when we Yan-

kees will appreciate the fruit as the English do, when we understand the growing of them and how to use them; for a canned Whitesmith is certainly delicious, and a gooseberry tart makes a rare dessert, and has only to be eaten to be appreciated. Grow them under your grapevines or among your trees, as these English varieties seem to flourish best in partial shade.

Passing to the tree fruits, I will say that my experience with peaches is a past number, and I am only growing plums in a small way. I planted and grew in health and beauty some thousands of peach trees some fifteen years since, but the extreme cold killed the buds and ruined the trees, so I never obtained a paying crop. But the peach is a grand fruit, and it was a grand sight that met my vision as I looked over J. H. Hale's peach orchard on June 15 last, from the tower erected for observation in the midst of trees covered with their dark-green foliage and loaded with fruit, which I learn has fulfilled every promise, even to filling a basket with thirty-nine Elbertas. It is useless to attempt peach culture unless you have a proper location. The influence of the sunny days in winter is oftentimes as serious as the late frosts of spring.

The culture of the pear and the apple has come to be considered as almost identical. In either case success cannot be assured without cultivation, fertilization and most persistent work early and late with the spray pump and the various fungicides and insecticides that are necessary to keep in check and destroy the numerous enemies of these fruits. Perhaps in no year have the advantages derived from spraying been more apparent than in the present year of 1897: first, because of sufficient rainfall in the eastern section of our country to render the fertilizers available for the growth of both foliage and fruit; and, second, because of this rainfall fungous growths have been multiplied, and only where the spray pump was persistently used do we find clean, sound fruit. Farmers as a class are negligent in this respect, and we have only to observe the character of the fruit in our local markets to become convinced of the fact; and the low price at which most of their fruit is being or has been sold in our markets is the result of this neglect.

In contrast to this, and as an object lesson of great interest, illustrating more forcibly than words can describe the advantages resulting from thorough cultivation and persistent spraying, I want to take you to the orchards of W. H. Hart, about three miles east of Poughkeepsie, and in your mind's eye see what I saw on the fifth day of last September, when I took Geo. T. Powell and Professors Clinton and Duggar of Cornell University out there to visit the orchards.

These orchards cover eighty acres, mostly upon a sidehill facing the west. The land is broken by ledges of rock and rises by plateaus as it extends eastward, not valuable for general agriculture, but made valuable for fruit growing by the treatment it has received. Much of the older portion of the orchard was set to Greenings, Baldwins and other varieties grown thirty to forty years ago. These trees were heavily loaded. But go with me farther on, to the orchard set twenty-five years since with Northern Spy, Baldwin and Ben Davis, the trees bending and some breaking under their loads of from five to eight barrels to the tree. Standing at a central point, on a visit made when the fruit was ready to pick, October 1, and looking adown these rows of trees extending on either hand till the fruit was lost to view, the sight was grand. The dark red of the Baldwin, which hung literally like ropes of onions; the brighter blush and stripes of the Spy, magnificent in size, many weighing twelve ounces each and measuring twelve inches in circumference; the hundreds of trees of Ben Davis, fairly ablaze with its bright red fruit, some of these trees set in 1889 bearing two barrels of apples, — were objects of extreme beauty. Consider that, standing at this place, the eye took in at a glance at least one thousand barrels of this highly colored and truly magnificent fruit, and that the entire crop of this orchard was not less than five thousand barrels, and we are ready to exclaim "The apple indeed is king."

You may well ask what produced this magnificent crop. It is the outcome of years of trial and of work. The results are for us to profit by. The soil, naturally thin, had been fed in former years with stable manure, but latterly with potash and phosphoric acid, and crops of crimson clover

have been grown upon it. On September 5 the clover was from six to ten inches in height, and the value of this crop to the soil was estimated by Professor Clinton to be fifteen dollars per acre. Walking over it, it was like treading upon a carpet, so loose and mellow was the soil.

I visited this orchard by request of Mr. Hart in 1893, to critically observe the effects of stable manure and potash and bone as applied to different parts of the orchard. This was before crimson clover was grown on the land. I found that the nitrogen in the stable manure had increased the size of the fruit over that fertilized with the bone and potash, but at the expense of color and firmness. The latter was of much higher color, was smooth, hard and glossy, and had a higher market value, particularly where wanted for shipment to foreign markets, as its carrying properties were far better.

The effect of growing crimson clover upon orchards, as shown by an analysis of the soil on the farm of George T. Powell, where three successive crops had been grown, has been a capacity for holding thirty per cent more moisture than was found in an adjoining orchard where no clover had been grown. This furnishes another proof that water in the form of moisture in the soil can be obtained by the incorporation into the soil of humus, which can be supplied by green crops, upon which the microbes in the soil work and store up nitrogen, the most costly of all fertilizers. Therefore *water* and *humus* are proved to be indispensable to the successful production of crops in agriculture or horticulture.

This brings us to the consideration of the second part of our subject — the marketing of fruit.

Marketing of Fruit.

It may be truly said of this subject that it is not a theory but a condition that confronts us. Whether it be over-production or under-consumption, the fact remains the same, that our markets every year, under the varying circumstances of production and climatic conditions, become congested, overloaded and demoralized. We must look for this more or less, because of the perishable character of some

fruits, which, if not soon disposed of, become unsalable; therefore very much depends upon the fruit offered for sale.

Therefore, the first condition that confronts us is the character and market value of the fruit. If those conditions have been complied with, to which your attention has been called in the raising of fruit, then we are prepared to proceed to the consideration of the best methods of placing that fruit upon the market.

This brings us to the question of packages in which to transport our fruit to market, — a question that has very much to do with the matter of profit or loss to the producer.

The selling of fruit by the package instead of by the pound or measure has been a source from whence *fraud* and *deception* on the part of the producer have been met by distrust and unbelief on the part of the dealer and consumer, to the ultimate loss of the producer. It has led to the making and using of packages of all sizes and shapes, the chief aim and purpose being to give the consumer the least possible amount for his money, — in a word to *cheat* as much as possible; and to such an extent has this been carried on that one manufacturer near me has made to order *eight* different sizes of grape tills, also *skin* quarts and pints.

I find that each fruit-producing section in our county has some package peculiar to that section; and while it is undoubtedly true that you must meet the demands of the market using your fruit, I believe there is no necessity for so many kinds. Some are better than others; and action should be taken by agricultural as well as horticultural societies — for this is a matter that is of interest to shippers of vegetables as well as shippers of fruits — to regulate the size and kind of package, that this element of fratricidal war between packages may cease to influence the market. While it is right and proper to get the best price we can for our fruit, let us be honest, and give full weight and measure.

Now, among all these different kinds of packages there is none, in my opinion, that meets the requirements of the shipper of small fruits as well as the thirty-two-quart crate, as quarts and oval pints fit equally well, and tills for grapes make it available for that purpose, obviating the necessity of having any other size of package.

The expense of marketing our fruits in this package will be less than when smaller packages are used, and when we have uniform packages we will be in a situation to secure lower and uniform rates for transportation, there being but a few cents' difference in the cost of the thirty-two-quart crate and the smaller sizes. It has been estimated that many thousands of dollars would be saved to the producers in the Hudson valley by using larger packages, especially for grapes.

It being an accepted fact that we must use the gift package for most of our products, I believe it would be to the advantage of all that the size of the package should be established by national law, and the manufacture and sale of *snide* packages be punished by fine or imprisonment or both.

It is a well-known fact that in many of our cities the street pedler of berries makes forty baskets out of a thirty-two quart crate. I am informed that one dealer in New York City sold one million of these *skin* quarts in one season.

Now, having our package, what shall we put in it, and how shall we pack it? Standing in the front of a commission house in New York City on the twentieth day of October, and looking over the vast amount of fruit to be seen on every hand, the proprietor made the remark, "If this fruit had been assorted, and the best half of it sent here, it would have netted more money to the sender than the whole will now, for it is the poor fruit that depresses the market and paralyzes trade." This shows the necessity of carefully grading our fruit and keeping the inferior stock out of the market. When this is done, and the purchaser finds that he can depend upon a certain mark of fruit, the problem of marketing that fruit is solved.

Believing that we cannot expect any material increase in the selling price of our fruits so long as the present methods are followed, I can but recommend for your consideration these several points which I have presented, viz.: —

First. — Improved methods in culture and preparation of the soil.

Second. — The selection of varieties suited to soil conditions and the demands of the market where sold.

Third. — Standard packages established by law, suitable for each class of fruit.

Fourth. — The proper grading and packing of fruit.

Fifth. — Organized effort, through State and local organizations, to secure just and equitable charges for tranportation.

Could these measures be carried out, I believe the results would be increased consumption of fruit, because of better quality, a more satisfactory state of the market, ready sales, quick returns, more profit for the producer and more satisfaction to the dealer and consumer.

I plead the necessity for organized effort, because individual effort avails but little. For ten years in our farmers' club and farmers' institute work I have been pleading for it, and yet I have to confess that I almost despair of ever seeing the farmers unite to defend themselves against other organizations that live out of the products of their labor and toil. But I believe that along the lines I have indicated there is a chance of saving a profit that others are now taking from us.

In conclusion, I want to say to you, my fellow laborers in the fields of agriculture and horticulture, that, while discouragements and trials frequently fall to our lot, we are engaged in a noble calling; that it is ours to live close to the great heart of the universe; that we can turn the curse which fell upon Adam into the richest of blessings, because in its exercise there comes to us a realizing sense of what life, liberty and the pursuit of happiness means. And, as we breathe the pure air of heaven and contemplate the bloom and fragrance of the springtime, or the rich fruitage of the autumn, under the brightening skies of May or the mellow hues of an October day, let us be mindful of the fact that ours is the noblest profession of them all, and that we should ennoble it by raising the standard of our ambition high, and strive to leave the world better for our having lived in it.

The Chairman. The gentleman has given us a very instructive and elaborate description of the methods by which he grows fruit. I have no doubt there are those here who

are pursuing that business, and I know many can draw benefit from the suggestions he has made. No doubt there are many who would like to ask questions. There is now an opportunity.

Mr. CRUICKSHANKS. How many crops of strawberries do you find it profitable to take from a bed?

Mr. TABER. Usually two. In some cases, because of the weeds, particularly if white clover or sorrel comes in pretty readily, it is better not to carry them over at all. There would be too much labor involved to keep the bed clean. While I say I cannot grow a new bed of strawberries under one hundred dollars, I can carry over a bed for fifty dollars that will give me generally just as good returns as I get the first year.

Mr. CRUICKSHANKS. Do you find some berries better adapted to your method of carrying over than other varieties; and, if so, what are they?

Mr. TABER. In growing a number of varieties of course I have treated them all alike, yet I have found that some varieties do not do as well under that treatment as others. I have not made any particular note of that point. Some varieties send out so many runners that they fill the ground full of roots. We cannot expect them to have the life and vigor that the other plants have. I think we want to avoid these varieties that fill the ground so full of roots the first season.

Mr. CRUICKSHANKS. Don't you think giving the Marshall your treatment would overcome the lack of productiveness in a measure.

Mr. TABER. I have not tried it. It is a very strong grower.

Mr. HINES (of Taunton). I would like to ask how this Mr. Hart came to raise such a crop of apples this year, when everybody else had them last year. Has he some scientific method by which he has changed the year of bearing?

Mr. TABER. We know that trees are in the habit of bearing one year, and not the next. It is because they over-bear. They cannot carry the large amount of fruit, and also perfect fruit buds for another year. If we can divide the energy of a tree so as to perfect a certain amount of fruit and leave sufficient for another season, we have obtained the victory

over that trouble. The energy of the tree may be increased by the methods of cultivation, so there will be strength enough for both. Of course this is in a measure a matter of varieties. Mr. H. secures a good crop of apples every year. I cannot tell why there should be crops of apples in the two counties of Dutchess and Columbia that almost equalled the crop of the rest of the State, but such is the case.

The ground in this orchard is so uneven that he cannot plough it very well, so he cultivates it with the spring-tooth harrow. He keeps it up until the first of July, then sows crimson clover, and there is a mulch all over the ground that keeps the apples growing and the trees in fine condition. Two or three years ago I know he used five hundred dollars' worth of potash and bone on his orchard in the fall. I believe it is the vigorous, healthy condition that he keeps his trees in that causes the production of such apples.

Mr. Hines. Were there many apples in those two counties last year?

Mr. Taber. There was a very large crop of apples there last year. You cannot easily imagine the difference in the fruit. While in our markets the apples are coming in from different farmers, showing evidence of fungous growth and insect troubles, the character of his Northern Spys, weighing twelve ounces and almost a foot in circumference, were just as clean and smooth as could be. He sprays his orchard twice or three times. You cannot get such fruit without spraying. It is impossible to do it. Last year (1896) there was very little difference between the sprayed and unsprayed fruit. We did not have the fungous growth, because it was dry. But in 1897 those who did not spray did not get much fruit. Spraying is one thing we have got to do, and have got to do it every year. It is of just as much value when your orchards are not producing as in the years when they are.

Mr. Pratt. I am interested in that matter of mulching. Does the crimson clover spring up the second year, or do you reseed?

Mr. Taber. Crimson clover is an annual. It will renew itself if you let it go to seed. But it has to be seeded every year. It does not live over. If you sow it in the spring it

will go to seed and die before winter, but by seeding in July or August it does not attain to that growth, but lives over through the winter and comes on in the spring if not winter-killed.

Mr. PRATT. What is the advantage of the crimson clover over the other for mulching?

Mr. TABER. I think I stated yesterday that I was growing both. The crimson clover makes a very quick growth, and it is calculated that the work of the microbes on it will store up more nitrogen than in the other. The fact is, that there is but little difference if carried over to be ploughed under in the spring. I am using both the crimson clover and the mammoth. I have cut one crop of mammoth clover in the spring, and then, as the clover grew up, I have been over it with a smoothing harrow to break it right down, and repeated the process. By keeping it down and preventing its seeding, I carry it through the fall and cover the ground perfectly with this mulch, and carry it through the winter and turn it under in the spring ready for strawberry plants.

Mr. R. C. BRECK (of Bridgewater). Are quinces grown in your State? It seems almost impossible to get a fair quince about here. Our trees are liable to blight and black-knot. I would like to know how they get fair quinces in New York.

Mr. TABER. Very few quinces are raised in our section. In New Jersey they raise very good quinces. I have seen some very fine ones in our State, but do not know where they come from. The experiment station showed some splendid ones at the American Institute fair. At this fair they had an exhibit of one hundred and ninety-three varieties of apples, and at our horticultural meeting last winter they had one hundred varieties. These apples kept over until the 20th of March, and were as smooth and glossy as you please. It was perfect fruit. I had the good fortune to take them home and it was an object lesson to me.

The CHAIRMAN. We shall have to close this discussion, as you will notice by the programme that a lecture will be given at 11.30 on "Irrigation in fruit culture," by RICHARD HITTINGER. He is not here, but he has prepared a brief paper describing his plan of irrigating his grounds, and Secretary SESSIONS will read it.

Irrigation on Our Farm.

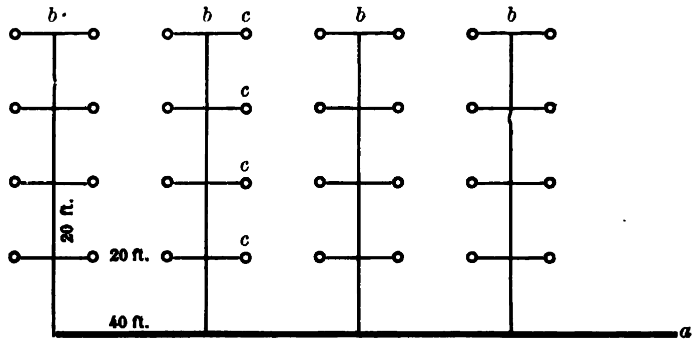
BY RICHARD HITTINGER, BELMONT.

About sixteen years ago we began to irrigate our farm to a small extent. We first drilled an artesian well on the highest part of our land to the depth of one hundred and thirty-five feet. This well, six inches in diameter, yielded ten gallons per minute, by means of a windmill, which in windy weather pumped from two to five thousand gallons in twenty-four hours. Close by the well is a reservoir of brick, thirty feet in diameter, ten feet deep, and with a capacity of fifty thousand gallons.

Four years later we put up several greenhouses. Our water supply, however, was not sufficient for the greenhouses and other uses about the farm, inasmuch as the town of Belmont had at that time no public water supply. We therefore thought it advisable to drill another well near the greenhouses themselves. This was bored to a depth of two hundred and fifty-five feet. The diameter was eight inches to one hundred and fifty-five feet below the surface, and six inches the rest of the way. The well yielded fifty gallons per minute, and when attached to a Dean deep well steam pump the water was forced to the reservoir, sixty feet higher than the top of the well. In this way the reservoir was filled in about twenty hours.

After getting the supply, we undertook more extensive irrigation in the form of lawn sprinklers. At first we used them successfully over a hot-bed of cucumbers of four hundred sashes. The sprinklers were divided into four sections, with eight sprinklers to a section. The whole system was fed by a two and a half inch pipe. The four sectional pipes of one and one-fourth inches branched from the main pipe at a distance of forty feet from each other. The

sprinklers, placed at the ends of three-eighths-inch pipes projecting from the sectional pipes, were so arranged as to be twenty feet apart.



a = Main pipe. b = Sectional pipes. c = Sprinklers.

By this method there was an equal distribution of water over the whole patch. These sprinklers, by the way, are known as the Neora lawn sprinkler, obtained from the Walworth Manufacturing Company, Boston.

Now, as regards our process of sprinkling, we were accustomed to water every other day, weather permitting, and used two sections at a time, for the main pipe was not large enough to supply them all at once. The two sections sprinkled from half to three-quarters of an hour, and thus when all four sections had been used the patch was watered in one or one and a half hours.

To illustrate the rapidity and convenience of this method, it is enough to say that it would take two men with three-fourths-inch hose three or four hours to do the same work in a less thorough fashion. At the same time, this system of sprinkling had its disadvantages. When the sprinklers had not been used for some time a scale rust was apt to form in the pipe. This collection of rust became loosened when the water was again turned on, and at length stopped up the sprinklers.

Owing to the large amount of rain during the past summer, we seldom used the sprinklers. Our experience has taught us, however, that this mode of watering is now in a rather crude state. Still, it has given thus far satisfactory

results. One particularly noticeable feature of the method is that the ground is kept in a soft and spongy condition, on account of the gentleness of the spray.

It will be observed that the more pressure brought to bear on the pipes the better will be the result, as the sprinklers will revolve faster and throw the water to greater distances. It is asserted, furthermore, that under a pressure of fifty pounds the spray will form a circle of fifty feet in diameter. Naturally the cost of watering is determined by the pressure, for under heavier pressure fewer sprinklers are needed. The watering can be done at all times with equal facility, as one man can regulate the whole system.

Adjourned at 12 M.

AFTERNOON SESSION.

The meeting was called together at 1.30 P.M. by Secretary SESSIONS, who said: The Orient Quartette have come here to give us a treat, as a recognition of their appreciation of our efforts here for the good of Bristol County agriculture.

Song by quartette.

Secretary SESSIONS. By special request the quartette will now favor us with the song they sang on Tuesday, and they will also sing again during the afternoon.

Song by quartette.

Secretary SESSIONS. Mr. Wood, our vice-president, has directed me to say to you that Mr. CRUICKSHANKS will preside this afternoon. He is president of the Massachusetts Fruit Growers' Association, and is most thoroughly interested in fruit and its culture.

The CHAIRMAN. This forenoon we touched upon almost every fruit, with the exception of the cranberry. We have with us this afternoon a gentleman who is, perhaps, better equipped to give instruction as to the enemies of the cranberry than any other individual in this country. The lecture is entitled "Insects injurious to the cranberry and other fruits," by Prof. CHARLES H. FERNALD of the Massachusetts Agricultural College. I assure you it gives me great pleasure to introduce to you Professor FERNALD, who will now address you.

INSECTS INJURIOUS TO THE CRANBERRY AND OTHER FRUITS.

BY PROF. CHAS. H. FERNALD, AMHERST.

CRANBERRY INSECTS.

My attention was first called to the injuries caused by cranberry insects seven years ago, and I was requested to investigate the matter. My first thought was that the industry was not of sufficient importance to justify the expenditure of time and money that would be necessary to obtain results of practical value to those most interested. I therefore looked into the matter, and learned, to my surprise, that the cranberry industry was not only a large and important one in this State, but that it was rapidly increasing.

The "Yarmouth Register" of Dec. 20, 1890, gave some very instructive statistics regarding this industry during the years 1883 to 1890 inclusive, showing an increase, during those years, from 32,079 barrels in 1882 to 89,886 barrels in 1890. These statistics indicate only the number of barrels shipped over the Old Colony Railroad, and represent only a part of the entire yield of the State. The number of barrels given in the above-named paper for the year 1885 was 66,063, but the State census for that year gave 105,106 barrels for the yield of the entire State; and when we consider how the data for the State census was obtained, we may feel confident that the entire yield was more rather than less than the amount given in that report. The yield for 1891 has been given as 157,000 barrels, and I have elsewhere estimated that the value of the crop for that year could not have been much below $1,000,000. Whether these estimates were at all accurate, I do not know; but they were sufficient to assure me of the importance of the

industry, and that I was warranted in spending time and money in investigating the insects which I was assured by practical cranberry growers destroyed on an average one-half of the crop on such bogs as could not be reflowed. I am not able to say how correct this estimate may be, but I have visited many a dry bog where no insecticide was used, and where not a cranberry was raised.

During the last seven years a large percentage of the cranberry bogs in Barnstable, Bristol and Plymouth counties have been visited either by myself or one of my assistants, and very careful studies have been made of the insects attacking the cranberry. In this work we have found a larger number than has generally been supposed to feed on the cranberry, some of which are seriously injurious, while others are not abundant enough to cause noticeable injury, though they are liable at any time to increase in numbers and become as destructive as those that are now giving so much trouble, while still others are only occasionally abundant in restricted localities, as the army worm (*Leucania unipuncta*). There are three different species that seem to cause the greater part of the damage on the cranberry bogs in Massachusetts, so far as I have been able to learn, and these are the vine worm, the fruit worm and the cranberry span-worm.

The Vine Worm.

The vine worm, also known as the fire worm and black-head (*Rhopobota vacciniana*), is undoubtedly the most destructive of all the cranberry insects occurring in this State. This insect has two broods in a year. The moths of the second brood fly about over the vines during the middle of June or later, owing to the season or other circumstances, at which time they lay their minute, yellowish, scale-like eggs on the underside of the leaves, where they remain during the winter. The time of hatching in the spring depends not only upon the season, but also upon the time when the water is drawn off from the bog. If the water is not drawn off till late, and the vines are not all submerged, the eggs on the leaves above the surface of the water will hatch, while those under the water will remain till

after it is drawn off before they hatch, so that we may have the vine worm in all stages of growth at the same time on a bog where these conditions have occurred. The first brood of vine worms does not appear to be numerous enough to cause a great deal of damage, so far as I have heard, but they give rise to a progeny in the second generation which is perfectly appalling. I have walked over bogs on Cape Cod where at every step the moths of this species flew up by the hundred, only to settle down again as soon as I had passed. I do not wonder, in cases where the moths are so numerous as this, that the vine worms hatching from their eggs should be abundant enough to devour every leaf on the vines. It is because of these varying conditions that the cranberry growers are sometimes at a loss to know just when to apply insecticides.

In dealing with this insect I would strongly advise those in charge of the bogs to watch carefully for the hatching of the eggs, and as soon as the young begin to appear, to spray the vines with arsenate of lead in water in the proportion of two or three pounds to one hundred and fifty gallons, adding two quarts of glucose, to aid the insecticide in adhering to the leaves. In my bulletin on cranberry insects published in May, 1892, I recommended the use of Paris green, and made no reference to arsenate of lead, which was not discovered till in the summer of 1892, after the publication of that bulletin. Since that time this new insecticide has been tested so thoroughly, both in this State and elsewhere, that I have little hesitation in expressing the belief that it will in time entirely supersede Paris green as an insecticide. I gave a full account of arsenate of lead and the experiments performed with it in Bulletin No. 24, of the Hatch Experiment Station, published in April, 1894. Since that time the gypsy moth committee has used several tons each year in destroying the gypsy moth, and I am informed that it is now very generally used by farmers and fruit growers in New York, New Jersey and elsewhere. The use of this insecticide has now gone beyond the experimental stage, and our knowledge of it is as exact as that of Paris green.

The advantages of arsenate of lead are that it remains in

suspension in the water much longer than Paris green; that it is white in color and can be readily seen on the leaves, so that one can tell at a glance what has and what has not been sprayed, which is often a great convenience; but the greatest advantage is that it does not injure the foliage, even when used in as large proportions as twenty-five pounds or more to one hundred and fifty gallons of water. Many people object to the use of Paris green, as it so frequently injures the foliage. This is undoubtedly because they use too large a proportion, or else they do not keep it properly stirred all the time it is being sprayed on the plants. No such trouble arises in the use of arsenate of lead, but it should be constantly stirred during the spraying, to secure an even distribution of the poison on the plants.

Several persons have reported to me that they have seriously injured their plants by the use of arsenate of lead when they followed the rule given in the above-mentioned bulletin. This rule was to put eleven ounces of acetate of lead and four ounces of arsenate of soda into a hogshead containing one hundred and fifty gallons of water. In one of the cases the man acknowledged that he reversed the proportions, and used eleven ounces of arsenate of soda and four ounces of acetate of lead. No wonder the leaves were burned. There were others, however, who found that arsenate of lead burned the leaves even when the proper proportions of the ingredients were used. In this case I imagine that the arsenate of soda was put in first and dissolved, and then when the acetate of lead was put in the arsenate of soda at once formed a surrounding layer of arsenate of lead, which, being insoluble, prevented the interior mass from dissolving, and thus a large quantity of arsenate of soda remained in the water, and when sprayed on the trees would surely burn the foliage. To avoid all such difficulty I would now recommend that eleven ounces of acetate of lead be put in four quarts of water in a wooden pail, and that four ounces of fifty per cent arsenate of soda be put in two quarts of water in another wooden pail, and, when they are entirely dissolved, pour each of them into a hogshead con taining about one hundred and fifty gallons of water, when

a chemical reaction will take place, forming arsenate of lead as a fine white powder in suspension in the water. If cold water be used, the solution of the acetate of lead will require fifteen minutes or more; but if the water be hot, the substance will dissolve very quickly. I do not need to remind you that arsenate of lead is poisonous, and should be used with the same care as Paris green. I have been somewhat explicit in describing the preparation and use of arsenate of lead, as I believe it to be the best insecticide we have at the present time, not only for cranberry insects, but also for all leaf-eating insects.* So far as our observations go, arsenate of lead is not washed off from the foliage by showers so easily as Paris green, and more or less of it remains for a long time.

THE FRUIT WORM.

The fruit or berry worm (*Mineola vaccinii*) appears on the bogs about the time the berries are beginning to set, from the first to the middle of July, according as the season is early or late. The female lays an egg at the blossom end of the young berry, often beneath one of the triangular lobes of the calyx. This egg hatches in five or six days, and the young fruit worm feeds for a day or two on the outside of the berry before making its way into the interior of the fruit. If the vines be sprayed at the time these eggs are hatching, or a day or two earlier, the first meal would prove fatal to the worms, and I have no doubt would destroy a large percentage of them, just as in the case of spraying apple trees for the destruction of the codling moth. Whether it will pay to spray for this insect will depend upon their abundance. If there are but few on a bog, it would not be worth while; but if they are abundant, it would undoubtedly be wise to spray the vines with an insecticide.

* This detailed statement of the method of preparing arsenate of lead will serve as a further explanation of the recommendations given in Bulletin No. 24. Later experience has shown that it is usually desirable to use a greater quantity of the insecticide to one hundred and fifty gallons of water than is here mentioned, as will be seen by recommendations on page 146 of this volume. In such cases it is necessary to adhere strictly to the relative proportions of the ingredients and manner of mixing as given above.

The Cranberry Span-worm.

The cranberry span-worm (*Ematurga faxonii*) is occasionally so abundant as to do much damage on bogs where it occurs. I visited several bogs where it absolutely ruined the crop for that season. Those which I bred laid their eggs on May 28, 1896, and hatched in twelve days. The caterpillars fed on cranberry leaves, reaching their full growth July 13, when they went just below the surface of the ground and changed into dark-brown pupæ, in which state they spent the winter, and the moths emerged during the latter part of the following May. This insect has been known to feed on arbor vitæ or cedar (*Thuja occidentalis*) as well as on the cranberry.

If the cranberry growers would learn to recognize these insects in their different stages, it would aid them very much in destroying them. If this particular moth which gives rise to the cranberry span-worm should be seen flying in large numbers over a bog late in May or early in June, we may expect trouble from the span-worms, and should make preparation to spray the bog with arsenate of lead at the time the eggs are hatching, or about the 10th of June. It is extremely unwise to wait till they have grown and devoured the leaves to such an extent as to ruin the crop for that season, for it costs no more to spray early than it does later; and, further, the younger the caterpillars are, the more readily do they succumb to the poison.

Other Cranberry Insects.

In addition to this, there is a second species of span-worm (*Eupithecia implicata*) which we have found feeding on cranberry vines. It is much smaller than the common species, being only about as long as the vine worm. So far as I can learn, they are nowhere very common on the bogs; but I know of no reason why they may not at any time become abundant, and cause as much damage as the larger species. This insect is known to feed not only on the leaves of the cranberry but also on cedar (*Thuja occidentalis*), juniper (*Juniperus communis*) and different species of oak.

The tip worm (*Cecidomyia vaccinii*) is comparatively

common on the Cape bogs, but I very much doubt if it does much harm, for, if it destroys the terminal bud, lateral buds will develop into shoots the next year and give a crop of fruit.

There are several different species which attack the roots or base of the stems, as the so-called girdle worm, of which there are two entirely different species that girdle the stems near the ground. One is the caterpillar or young stage of a small yellowish moth (*Crambus hortuellus*), which lives in a vertical tube on the ground, which it constructs of bits of vegetable material held together by silk spun by the caterpillar. They feed mostly by night, coming out of their tubular dwellings and eating the bark near the ground, girdling and killing the vines. I have seen this insect flying about over nearly every bog I have visited. Another insect (*Carneades detersa*), belonging to the cutworm family, feeds on the bark, but girdles it in a more irregular manner than the other. Sometimes the army worm attacks the bogs, but the work of this insect occurs only occasionally, and then not over extensive areas. Spittle insects often occur on the vines, and the froth which covers this minute sap-sucking insect makes so much of a show that one might be led to suppose that these spittle insects would ruin the vines; but if one should remove the froth, and discover how small the insect really is and how little sap it requires for its nourishment, he would realize how little damage is being done by these insects.

I have now treated of the insects most injurious to the cranberry, but the second part of the subject is rather perplexing, for the reason that the number of insects attacking fruits is legion. From this multitude I will first call your attention to some observations that I have made on canker worms, which are so common in various parts of the State.

Four years ago canker worms began to increase so rapidly in Amherst that public attention was called to them, and a general account of the species occurring in Massachusetts was given with illustrations in Bulletin No. 20, published in January, 1893. In that bulletin the usual remedies were given. These consisted of tacking bands of heavy paper around the trunks of the trees and painting these bands

with prepared printer's ink, repainting as often as it became dry or hardened enough to permit the females to cross the band. The method of protecting the trees with oil troughs of zinc or tin around the trunks was also mentioned. It was finally stated that probably the most effectual method was to spray the trees with Paris green in water as soon as the eggs hatched in the spring. A further account of canker worms was given in Bulletin No. 28, published in April, 1895.

A careful study of the different methods used to destroy these insects, which are so prevalent in many parts of this Commonwealth, has been made on thirteen apple trees on my own premises in Amherst. Three years ago these trees were carefully banded with heavy paper and painted with Morrill's tree ink early in the spring, when the first females began to ascend the trees, and the painting was repeated as often as necessary. It was found that the ink would often harden on the trees, even during the night following the application, and remain hard on the shady side long enough in the morning for some of the females to ascend the tree on that side, so that this method did not prove to be a perfect protection. The cost of the materials and of their application averaged about fifty cents to each tree.

The oil troughs are also quite expensive, and often leak so that the rain displaces the oil and then evaporates, allowing the females to ascend the trees; or spiders spin their webs across beneath the overhanging protection, forming a bridge over which the moths may easily pass, so that this device does not form a perfect protection.

Two years ago these trees were sprayed with Paris green in water in the proportion of one pound of Paris green to one hundred and fifty gallons, at a cost of five cents a tree, allowing fifteen cents an hour for labor. There was a strong wind blowing, and more time was required to do the work than would otherwise have been the case. Last year the same trees were sprayed with Paris green in the same proportion as before. At this time it was nearly calm, and the cost of spraying was three cents a tree. The contrast between these trees and those on adjacent lots was very marked, for the sprayed trees retained their foliage and

yielded a full crop, while the unsprayed trees were stripped of leaves and bore no fruit. These trees were sprayed but once, and this method appears to have been more effectual and far cheaper than the others. In case of rain it might be necessary to repeat the spraying, but even then it would be the cheapest method.

Plant Lice.

Plant lice or aphids have been very abundant during the past summer, not only on fruit trees but also on ornamental trees and shrubs and in greenhouses. These insects have been sent to me from all parts of the State, with letters requesting information as to methods of destroying them. There is a very large number of species of these insects, and comparatively few of those in this country have been studied as yet. They all have their mouth parts developed into a sharp, piercing, sucking tube, which they force through the outer covering of the leaves or twigs on which they rest, and draw the sap from within. As these insects are very small, a few would produce no appreciable effect upon the vigor of the tree, but their powers of reproduction are so remarkable that they multiply prodigiously.

The last brood in the fall, almost without exception, consists of males and females, and after mating the females lay their eggs and then die. Early in the spring, as soon as the sap begins to flow, these eggs hatch, and the young lice, which are wingless females, at once insert their tiny beaks into the bark or leaf on which they are resting and begin to pump up the sap. They wander but little, but devote their entire time to feeding, hence they grow rapidly and soon reach maturity, when, without the intervention of males, they give birth to their young alive, one at a time; and in some species a single female gives rise during her life to one hundred or more young ones, each of which quickly develops, and after reaching maturity gives birth to wingless females; and so on, generation after generation, till the cool weather of the fall causes a change to take place, and the last generation consists of males and females. These mate, and the females lay their eggs, which remain on the trees and hatch in the spring as before.

A few years ago I attempted to determine the number of young a wingless female of our common apple louse (*Aphis mali*) would give rise to, and how many generations there would be in a year. For this purpose I selected a branch of an apple tree sufficiently near the ground to be easily observed, removed all the minute, polished, black plant-lice eggs to be found in the crevices of the bark except those reserved for the purpose in question, and marked the branch so that I should not fail to recognize it. These eggs hatched in due time, and the young lice crawled to the nearest leaves, where they established themselves and began to grow very rapidly. I carefully removed all but one louse from each leaf, so that the chances of error in the observation would be very small. Just at that time, when everything was going on to my satisfaction, a cold rain storm came on, which lasted twenty-four hours or more; and after it cleared off, much to my astonishment and dismay, there was not a plant louse to be found on that entire tree, and yet before the storm they were swarming over all parts of it except on the branch which I had cleared for my observations. This led me to conclude that cold and abundant rains were destructive to plant lice, and in wet seasons we might expect a dearth of them on our fruit and other trees. The experience of last summer, however, which was the most rainy season we have had for years, and at the same time one in which the plant lice were more abundant all over the country than I have ever before known them, leads me to the conclusion that I know very little about what climatic or meteorological conditions are favorable or unfavorable to the life of these insects.

Some very careful observations were made in Europe many years ago on the woolly aphis (*Schizoneura lanigera*) of the apple tree, which is quite as common in this country as in Europe. It was found that the wingless female hatching from the egg in the spring gave birth to about one hundred young in the course of her life, and that each of these also gave rise to about the same number, and so on for ten generations. This led me to make some mathematical calculations bearing on the possible progeny of a single plant louse hatched from an egg in the spring. If, as in the case

of the woolly aphis of the apple, each female of a given species should give rise to one hundred young, and if each of these should reach maturity without mishap and also give rise to one hundred young each, and so on for ten generations, the number in the last generation, determined by the rule of geometrical progression, would amount to one quintillion. Most people have very little conception of high numbers, and to gain a clearer idea of these figures let us bear in mind that one of these plant lice is about one tenth of an inch in length, and that ten of them, placed in a line touching each other, would reach an inch, one hundred and twenty so placed would reach a foot, and 633,600 would reach a mile. If we should divide one quintillion, the number in the last generation, by 633,600, the number required to reach a mile, it would give the number of miles that whole generation would reach if all those aphids were placed in a line and just touching each other, and this distance is 157,828,282,282 miles. This number again is beyond our comprehension. The earth is about 25,000 miles in circumference, and this string of plant lice would reach around the world more than 6,000,000 times, or it would reach from the earth to the moon more than 655,000 times, and it would reach from the earth to the sun 1,715 times.

I have called your attention in this way, that you may appreciate how very prolific plant lice are; and there must be a mortality among them every year that is perfectly appalling, and concerning which we know as yet almost nothing. Occasionally there is a season a little more favorable to the lice, as the past summer has been, when they multiply and cover every green thing; but even then the mortality among the lice must be beyond all comprehension. What all the conditions are that cause the destruction of so many plant lice it is impossible to say; but we know that the young of certain beetles feed voraciously upon them and assist greatly in reducing their numbers, but I can scarcely believe that there are not other forces at work that aid in holding them in check.

Six years ago I performed an experiment on plant lice on roses. Twelve potted rose bushes of different varieties were

placed in the insectary greenhouse, and, as they were found to have a few plant lice and red spiders on them, they were carefully protected till they multiplied and covered every green twig and more or less of the surface of the leaves. A pailful of kerosene emulsion was then prepared, and each rose bush was inverted, dipped into it and held there about a quarter of a minute, or long enough to allow the emulsion to reach every insect on the bush. An examination of the bushes two days later failed to reveal a single plant louse or red spider, and none appeared on them during the remainder of the season, thus proving that the work was not only thorough but effectual.

This method of killing the lice can only be applied to small plants in pots; but for trees and shrubs it becomes necessary to spray with kerosene emulsion for the destruction of plant lice. It must be remembered, however, that this is a contact insecticide, and every individual must be drenched with the emulsion to make it effectual. If a few of the lice escape this drenching, so great are their powers of reproduction, as shown above, that they will soon increase to such an extent that it will be necessary to spray the tree again.

To prepare kerosene emulsion, dissolve one-quarter of a pound of common bar soap in two quarts of boiling water, and, while still hot, add four quarts of kerosene oil and churn it for about five minutes through a small hand force pump with a small nozzle turned into the pail. When properly done, the whole forms a creamy white mass, which becomes jelly-like when cold. Care must be taken to have the solution of soap hot when the kerosene is added to it and the churning done, but it must not be near a fire. Before applying this emulsion to the plants, it should be diluted with water in the proportion of one quart of the emulsion to nine quarts of water, and then thoroughly mixed. The above will make sixty quarts of the insecticide ready for use. The emulsion will keep for a long time without injury, and may be diluted when needed for use. I have often had the feeling that when I have advised this plan and it has been tried, and a few insects have escaped and multiplied so that it would be necessary to go over the whole thing again, the

parties considered the recommendation worthless, while it is the best and only thing I can recommend.

THE SAN JOSÉ SCALE.

The San José scale (*Aspidiotus perniciosus*) is one of the most dangerous and destructive insect pests that threaten our fruit trees. This insect occurred in California as early as 1870, but no one knows, at the present time, of what country it is a native, or just how and when it was brought into this country. Since the time of its discovery in California it has rapidly spread, till it is now widely distributed over the United States.

My attention was first called to this insect in this State on March 29, 1895, when I was shown several young plum trees, on the grounds of the horticultural department of the Massachusetts Agricultural College, which were infested with the San José scale. These trees were received from the J. F. Lovett Company, Little Silver, N. J., in the spring of 1894. Knowing how extremely difficult it is to distinguish this from several other closely allied though far less injurious species, I sent specimens to the Department of Agriculture in Washington, to make sure that my determination was correct. Prof. L. O. Howard, who examined these specimens, wrote me that, while they were the true San José scale, the specimens sent were all dead. Wishing to determine whether any of these insects had survived the winter, I had two of the trees taken up and set out in the insectary greenhouse, and the remaining infested trees were burned. Scales appeared on the growth of the previous year, so that the insects flourished well, at least during the summer of 1894. On June 10, live scales were observed on the trees transplanted to the insectary greenhouse, and on the 14th the young were swarming all over them. As this settled the question of the ability to survive our winters in Amherst, I had these trees very carefully burned, to prevent any further spreading of the pest.

As soon as it was discovered that the San José scale had been received at Amherst on nursery stock from outside of the State, I feared that other nurseries might have become infested in a similar manner, and therefore sent one of my

assistants, Mr. Lounsbury, to examine nurseries in the eastern part of the State. A full account of Mr. Lounsbury's discovery in several places was published in the Crop Report for August, 1895, and also in the report of the Massachusetts Agricultural College for 1896. By direction of the committee of the Hatch Experiment Station, I sent Mr. R. A. Cooley, one of my assistants, early last May to examine the nurseries in this State, and after careful and painstaking examination of twenty-five, he was able to discover the San José scale in but three nurseries. Mr. A. H. Kirkland, my assistant in the gypsy moth work, had previously visited two of these three nurseries at the request and expense of the owners, and, finding them infested with the San José scale, had given them advice and explicit directions how to exterminate the pest. It was in one of these nurseries that Mr. Lounsbury first found the San José scale.

I think the owners of these three infested nurseries are keenly alive to the fact that it will prove ruinous to their trade to send out infested stock; and they are taking every precaution to avoid it, two of them having employed Mr. Kirkland to take charge of removing and burning all infested stock, while the other one has employed Mr. Cooley. These nursery owners seem to realize the fact that the laws of trade are as inexorable as the ancient laws of the Medes and Persians, which were said to have been written in blood, and that, if they wish to sell nursery stock, it must be free from the San José scale.

There is one point to which I want to call attention. Prof. F. M. Webster had some twigs sent him, to see if there were any San José scales on them. There were no scales to be seen on the twigs, but he happened to cut through a bud, and there was a San José scale behind that bud, entirely out of sight. If a person is going into a nursery and is going to pronounce that nursery absolutely free from the San José scale, it would be necessary to cut every bud off the trees, and even then I should doubt if he could be sure.

The young San José scales are born alive, and when they escape from under the scale of the mother appear as minute, dull orange-colored objects, scarcely visible to the naked

eye. They crawl about for a short time, but are not able to reach any great distance, though they may at this time, be transported by other insects or on the feet of birds to other trees in the same orchard or even to other orchards. After these young have crawled about for a time they settle in some suitable place on a branch or twig or even on the fruit, work their long, slender sucking beaks into the plant, and, in the case of the females, remain during the rest of their existence. Even before they become established, fine threads of wax-like substance begin to issue through minute pores on the surface of the body, and after they become fixed these filaments grow more numerous and longer, till the insect is entirely covered, and as they gradually fuse together, form the scale. As the insects grow, the males moult their skins once while the females moult twice, these moulted skins forming a part of the enlarged scale.

From the observations made on this insect in Washington, we learn that the female produces her young alive on an average of more than 10 a day, continuing for about six weeks, and resulting in a progeny of from 480 to 500 young from a single female. One female was seen to give rise to 587 young, by actual count. Professor Howard estimates that there are four full generations in Washington, and that the progeny of a single wintered-over female would amount to 3,216,080,400. From observations made in Massachusetts, the earliest recorded appearance of the young was June 14 and the latest November 4. This latter date is probably unusual; but, even if we accept a date in the fall so late as this, we can have but three full generations in a year. The fact, however, that each female gives rise to so large a number of young, even three generations, makes this a most formidable pest.

It was at first supposed that the San José scale would be confined to plants belonging to the Rosaceæ, which include among others our common orchard and garden fruits, as peaches, pears, apples, plums, cherries, quinces, apricots, raspberries, roses, etc.; but it was found that it would thrive on plants belonging to other families, including shade and forest trees, as walnuts, willows, elms, maples, locusts, persimmons, gooseberries and currants.

Natural Enemies.

The natural enemies of the San José scale, so far as known, are comparatively few. Three or four minute Hymenopterous parasites have been bred from it, but so far as I can learn they produce no appreciable reduction in the numbers of the scales. Several predaceous beetles are known to feed on them, as the pitiful lady bird (*Pentilia misella*) in the south and west, and the twice-stabbed lady bird (*Chilocorus bivulnerus*); and Mr. Kirkland informed me that he found the two-spotted lady bird (*Adalia bipunctata*) feeding on the San José scale in Auburndale, Mass., on October 9.

Prof. P. H. Rolfs of the Florida Agricultural Experiment Station issued a bulletin last August, in which he gave an account of the discovery in that State of a fungus attacking and destroying the San José scale and also other species of scale. This fungus (*Sphaerostilbe coccophila*) was found to destroy the San José scale by penetrating all through the substance of the insect, causing the death of large quantities, and as they dried and shrivelled they fell off, leaving the surface of the tree entirely clean, so that, when not too severely affected, the tree entirely recovered. Professor Rolfs made a careful study of this fungus, and, after experimenting with it on various substances to obtain a pure culture, found that he succeeded best when the fungus was grown on slightly acid bread, for the fungus permeated the whole piece and produced myriads of spores. A piece of this bread about an inch square was placed in a quart of water and shaken until it was broken up, and the spores evenly distributed in the water. This was then applied to the scale-infested tree by means of a sponge or cloth, or was sprayed on. Warm, damp weather proved favorable to the development and multiplication of the fungus and the consequent destruction of the scales, while dry weather was unfavorable to its growth. It was recommended to make the application after sundown on a moist evening, or, if the weather was dry, to wrap moist burlap or other cloth loosely around the treated limbs, for he found that it was only a question of a few hours whether the spores were to produce the disease, or die. If they were

in a moist atmosphere, they would grow; otherwise, they would not.

While this fungus is a native of a sub-tropical climate, it is an unsettled question whether it can be made effective in the northern parts of the United States. Professor Craig of Canada stated, at the meeting of the Association of Economic Entomologists, held in Detroit last August, that the San José scale occurred in British Columbia and in Ontario, where it had been known to exist for at least four years. He further said that fungous cultures, received from Professor Rolfs, had been used in inoculation tests in the laboratory, but with no practical results.

Artificial Remedies.

Many remedies have been tried for the destruction of the San José scale, both on the Pacific coast and in the east; and of these, but three methods of treatment have seemed to prove effectual in the east. These are fire, whale-oil soap and hydrocyanic acid gas, — and the best of these is fire. There is nothing quite equal to cremation for the San José scale. When a number of trees in a nursery are found infested, the safest and most effectual plan is to burn that entire block of trees, and also treat all others in the vicinity with whale-oil soap. This soap, two pounds to one gallon of water, is the simplest and cheapest preparation that has thus far been used; and it has proved comparatively satisfactory, though in some cases it is reported not to kill all the scales, even when used as strong as three pounds to one gallon of water. A solution should be made of not less than two pounds of the soap to one gallon of hot water, and applied while warm with a spray pump. Prof. J. B. Smith, who has had a large experience with the various methods of destroying this insect, thinks that the best results on bearing trees may be obtained by spraying them with whale-oil or fish-oil soap, at the rate of one pound to a gallon of water as soon as the trees are dormant in the fall, and a second time, at the rate of two pounds to a gallon of water, early in the spring, just before the buds begin to swell. After the spraying the trees should be carefully pruned, to get rid of as

many of the small terminal twigs as possible, and all of these twigs should be burned.

The gas treatment, or fumigation, as it is called in California, consists in covering the tree or plant with a tent or cover of some kind, to prevent the escape of the gas, keeping it covered from fifteen minutes to an hour. This tent should be made of duck, and receive two coats of linseed oil and lamp-black, the former to render it air-tight and the latter to exclude the actinic rays of light, as otherwise it would injure the foliage. It would be better, however, to perform this work by night, or on cloudy days. After putting the tent over the tree, raise the windward side from the ground and place an earthenware bowl, containing one fluid ounce of sulphuric acid (66°) and three fluid ounces of water, on the ground inside of the tent, and with a long-handled dipper or ladle pour one ounce of refined potassium cyanide (98 per cent) into the bowl, and immediately close the tent. This amount is sufficient for one hundred and fifty cubic feet of space within the tent. The chemicals react and form hydrocyanic acid gas, commonly called "Prussic acid," which is one of the deadliest poisons known, and must therefore be used with the utmost care.

It is a well-known fact that our nurserymen do not raise all the stock they have a call for, and to fill many orders they are frequently obliged to purchase from outside parties, and in this way they are liable to handle and sell infested stock unintentionally, even when their own nurseries contain no scales. Messrs. Southworth Bros., nurserymen in Salem, realizing this difficulty, have constructed a fumigating box twelve feet long and three feet high and wide, in which they propose to treat small lots of stock; but larger lots will be treated in their storage cellar, which is twenty-nine feet long, seventeen feet wide and eight feet deep. These gentlemen propose to carry out this plan, in spite of all obstacles.

Pure kerosene, applied either with a sprayer or brush, is the latest insecticide that has been recommended for the San José scale. Prof. F. M. Webster first called attention to it at the meeting of the Association of Economic Entomologists, held in Buffalo, N. Y., in August, 1896; and quite recently

Prof. J. B. Smith has issued a circular in which he strongly recommends the use of pure kerosene for this insect. In a bulletin by Professor Webster of the Ohio Station is a series of carefully conducted experiments with kerosene on fruit trees, which is very instructive. In this series were four pear, six apple, six peach, five plum and two cherry trees. One pear tree was killed, one injured and the other two were uninjured. One apple tree was killed, two slightly injured and three were uninjured. Four peach trees were killed and the other two were badly injured. One plum tree was slightly injured and the remaining four were not affected. The cherry trees were both killed. These trees were treated in the month of March. Twelve of them were sprayed with the kerosene, with the thermometer between 34° and 38°F., and it was applied to the remaining eleven with a brush, with the thermometer ranging between 40° and 45°F. No perceptible difference could be seen in the effect between the two methods of applying the kerosene. In view of the results of these experiments, carefully conducted by Professor Webster, I do not feel ready, at the present time, to advise the use of kerosene for the destruction of the San José scale, except for experimental purposes.

Before closing I want to call attention to this box, in which are some of the more common cranberry insects. [Specimens exhibited.]

The CHAIRMAN. Now, gentlemen, we have a short time for questions.

Mr. PRATT. I would like to inquire if Professor Fernald can tell us from whence we received the San José scale.

Professor FERNALD. It was first introduced into California. It was brought from there to New Jersey and Missouri nurseries.

Mr. PRATT. You have no knowledge of its being imported directly into Massachusetts?

Professor FERNALD. It occurs in Japan and some of the Pacific Islands, but I presume New England does not import any stock directly from there.

Mr. ——. A year or two ago arsenate of lead was for sale at grocery stores. I bought some and went over my potatoes

and the potato bugs were about as lively after I had applied it as before. I had to go over the vines with Paris green.

Professor FERNALD. I have stated some proportions in the paper which I did not read. In buying this commercial material, you must have the proportions given. There are two qualities of acetate of lead (the material to be mixed with arsenate of soda to make arsenate of lead) on the market. One has 50 per cent of arsenic, and the other has less. It is the fifty per cent which these conclusions are based on. In following the rules I have given, please observe the proportions, and insist on getting the fifty per cent quality.

QUESTION. Does this arsenate of lead come in a suitable form to be applied dry with one of those guns?

Professor FERNALD. So far as I know, it is not on the market in shape to be used dry; but if there is a demand for it, I have no doubt that there are people who will eventually supply the demand.

QUESTION. Is the formula in any of the bulletins of the Hatch Experiment Station?

Professor FERNALD. It has been published there, in the report of the gypsy moth department and also in the newspapers.

Mr. PRATT. Is it easy to detect this San José scale?

Professor FERNALD. It is not easy; you can scarcely see them.

Mr. TABER. Have you used the arsenate of lead in connection with the Bordeaux mixture?

Professor FERNALD. I do not think it has been tried.

Mr. MORSE (of Medway). Will arsenate of lead kill the larvæ of the potato beetle? I tried it, with unsatisfactory results. I put it on according to the formula issued by the experiment station. After waiting a day or two, I put it on stronger; then I put on Paris green.

Professor FERNALD. Your potato beetles must have a very different constitution from what they do at Amherst, for I have killed them very easily. There is this about arsenate of lead: You can use it in any proportion you like, and not be afraid of hurting your foliage. Perhaps you did not use it strong enough, or there might have been some fault in the chemicals or in the way you prepared it.

QUESTION. Does it have any effect on grape vines?

Professor FERNALD. It does not hurt any foliage.

The CHAIRMAN. A large portion of the lecture referred to the cranberry insects. We have some gentlemen here from Cape Cod, notably the son of the cranberry king, Mr. MAKEPEACE. We would like to hear from him.

Mr. MAKEPEACE. I feel that I have been entertained by what Professor Fernald has told us this afternoon. Of course we can ask many questions. I would like to ask Professor Fernald if in his experiments he has ever found anything which was effective in destroying the girdle worm?

Professor FERNALD. I never had an opportunity to experiment with insecticides upon them. We have done all we can at Amherst. Now what we need is to send a man onto the bogs to do field work. When we have performed experiments under cover, then we want to go into the field and see if we get the same results. That remains to be done, and I have not the means at my command to do it. There should be a man there to spend the entire summer.

Mr. MAKEPEACE. Do you think there should be more than one application of arsenate of lead for the fire worm?

Professor FERNALD. If they all hatched at once, and you applied it immediately upon their hatching, unless there are heavy rains, I should think one application would be quite sufficient. That is a thing to be tested in the field.

Mr. MAKEPEACE. We know that they do not all hatch at one time.

Professor FERNALD. Then I think you would be obliged to apply this frequently. Would it not be the same as in the use of tobacco water? You know many cranberry growers feel that it hurts the keeping qualities of the crop to flow the bogs. I think I found cranberry growers who did not flow their bogs, but preferred to use tobacco water instead.

Mr. MAKEPEACE. When they get so numerous that they eat bog and all, it is best to flow, if you can.

Mr. CROWELL (of Dennis). Has this mixture ever been tested in actual experience on a bog on the cranberry worm?

Professor FERNALD. It has, but I haven't my notes. Tests were begun by my assistant, but he had to take the report of the results from the people there. I think that it

has been found that, while sometimes the results appear to be perfectly satisfactory, at other times and under almost exactly the same conditions the results have been unsatisfactory. In my long experience I find that caterpillars are destroyed very much more easily when young than when nearly grown. Would it not be possible to draw the water early from the bogs, and have the worms all hatch at the same time?

Mr. ——. I think that the changes of temperature have considerable to do with that. Sometimes, if the temperature is right, they begin to hatch; and if there is a sudden change, the hatching of the others is retarded. I think I have seen something of that kind several times.

Professor FERNALD. I wish to say that, because of the peculiar country on Cape Cod, the hospitality of the people and the kindness they showed me, I have taken a more lively interest in the cranberry insects than in any other insects I have ever touched in my life. If I could help them, I would be glad to do it. But I am so bound up with my work that it is impossible for me to go down there and give the time the subject merits, and the station has not the money to pay expenses. If you gentlemen can suggest any way by which the expenses can be met, I would be very glad to go and see if I can do any more for you. I have thought of hydrocyanic gas, and wondered if it would be possible to put a tent over a portion of a bog, and liberate this gas and destroy the eggs. Nobody knows whether it would kill the eggs, or not. It has not been tested, to my knowledge. If it would kill all the eggs, I am not sure but it might pay to do it. The cost of any remedy must be low enough to allow a margin of profit.

QUESTION. Does the berry worm go from one berry to another?

Professor FERNALD. Yes, if it does not get enough to eat from the first one.

Mr. ——. I understood you that there is no known remedy for the berry worm at present?

Professor FERNALD. I did not say that. You can kill them in the same way you do the codling moth. Our fruit growers spray for the codling moth on apple trees, and you

can spray your vines for this worm. It is a question for the grower to decide whether it would pay to do it, or not. If there are only a few on the bog, it would not pay to spray the whole bog. I know nothing better for this purpose than arsenate of lead. It will not burn the foliage, and is a little cheaper than Paris green. You cannot kill them with tobacco water.

Mr. C. D. LINCOLN. We have on our strawberry bed a small beetle which sometimes completely destroys our young plants, and old ones too. It is about one-eighth of an inch long, black and shiny, and eats holes through the leaves. I have tried Paris green so strong that it would kill the leaves, with no effect on the insect.

Professor FERNALD. I have tried every insecticide I know against this insect, and have found nothing satisfactory as yet.

Mr. A. H. KIRKLAND (of Malden). One thing I think might be mentioned in connection with the use of arsenate of lead on cranberry bogs.

Secretary SESSIONS. Mr. Kirkland has had a very extensive experience with insecticides.

Mr. KIRKLAND. This arsenate of lead remains on the foliage in an effective condition for a long period of time. We have had this last summer, trees sprayed early in June, and we have found plenty of poison on the leaves in August. I do not know about cranberry insects, but I want to suggest that, if your bogs were sprayed with arsenate of lead at about the time the eggs begin to hatch out, the poison would probably remain on the vines for two or three weeks. Would not that cover the hatching time? Paris green washes off, but arsenate of lead will remain on the leaves during a great deal of wet weather; and the addition of from four to six quarts of glucose to one hundred and fifty gallons of water might cause the poison to adhere longer.

QUESTION. How much would it cost per acre to spray cranberries?

Mr. KIRKLAND. I have no figures that I can give the gentleman, but I might say that we have sprayed apple and oak trees which we estimated had a leaf surface of about three thousand square feet. We sprayed those trees for eighteen or twenty cents each, where we had spraying gangs working

throughout the day. We used arsenate of lead at the rate of twenty pounds to one hundred and fifty gallons of water. That is about five times as strong as you would need to use it. You could, therefore, save on the cost of the poison. These figures may help you in making an estimate.

Secretary SESSIONS. When spraying on the ground, you would save climbing trees. In the gypsy moth work we have made extensive and exhaustive experiments with pumps. We have a pump that we expect to use next year, with which one man, without much exertion, can use two or three lines of hose with a spray nozzle at the end of each. I think it would be worth your while to go to Malden to see the pump. I should suppose, if it would pay to spray with tobacco water, it would pay to spray with arsenate of lead.

Mr. KIRKLAND. Where the vines are dense, the poison would have to be used in a larger quantity, in order to wet through the vines.

Secretary SESSIONS. With our experience, we cannot tell what it would cost, because we have not come in contact with these conditions.

Mr. MAKEPEACE. In spraying for the gypsy moth, is it common to make more than one application during the season?

Mr. KIRKLAND. Where we spray during the forenoon and there comes a heavy rain at noon, we sometimes have to re-spray. If we spray when the caterpillars are small and the spray dries onto the leaves, one spraying is sufficient. As a rule, we do not have to re-spray.

QUESTION. Would the spray falling on the grass injure live stock or poultry?

Mr. KIRKLAND. In the case of poultry, it is better to shut the fowls up for a few days after spraying. In the case of live stock, I do not think there is any danger. Two years ago I sprayed an apple tree very thoroughly with arsenate of lead at the rate of twenty pounds to one hundred and fifty gallons of water. When I finished, the grass underneath was not very thoroughly soaked, so I turned the nozzle into the grass. I cut the grass and fed it in two feedings to an old horse that was about to be killed. The horse had a bad leg, but its digestion was all right. We fed some of the

grass in the morning and the rest at night, and the keeper said the horse felt better after that. There was no harm done.

Mr. TABER. I would like to say a word in regard to the San José scale. If I had heard nothing before about it, and had it on my place, I should be discouraged, because the professor has told us it is almost impossible to find all of the scales. That it is difficult to eradicate is true. But the man who owned that large orchard I described has it on his trees and he is not discouraged, for he knows he can keep them in check. They came from two trees that he set out some seven years ago, but after three years it had spread to only about five trees, and within the last two years it has spread to one hundred and fifty trees. I say, do not get discouraged. If you have it, fight it. We have to fight all these enemies. Professor Slingerland has had a great deal of experience in that line, and he tells us not to destroy our trees unless they are very thoroughly infested, because we can by the use of insecticides destroy these scales. If you have a tree that is not worth anything, you might just as well destroy it, of course. But this scale is not such a terrible enemy, after all, if we are ready to fight it. There is no use in backing out. We want to go to work and eradicate it.

Mr. W. A. KILBOURN (of South Lancaster). I desire to make a motion, which is especially deserved. It is that the Board of Agriculture thanks the mayor of the city, the Board of Trade, the poet, the Orient Quartette, the officers of the Bristol County Agricultural Society, the Reed & Barton Corporation and Senator Black for the courtesies and hospitable treatment which have made this public winter meeting so enjoyable.

Secretary SESSIONS. I rise to second that motion. This Board has been treated with great consideration and hospitality in every place where the public winter meeting has been held. Taunton is by no means behind in this respect, and I heartily second the motion.

The CHAIRMAN. All in favor of the motion, please rise. It is a unanimous vote. We are now about to close one of the most profitable and interesting series of meetings that this Board has ever held. I wish to announce also that the

average attendance from the first day has been rather larger than usual. It has been unfortunate that there was not more time for discussion. Undoubtedly a great many more questions would have been asked, if time had allowed. I now have to announce that this meeting is closed.

Adjourned at 3.45 P.M.

ANNUAL MEETING

OF THE

BOARD OF AGRICULTURE

AT BOSTON.

January 11 and 12, 1898.

ANNUAL MEETING.

In accordance with the provisions of chapter IV. of the by-laws, the Board met at the office of the secretary, in Boston, on Tuesday, Jan. 11, 1898, at 12 M., it being the Tuesday preceding the second Wednesday of January. In the absence of the Governor, the Board was called to order by the first vice-president, Hon. JAMES S. GRINNELL.

Present: Messrs. Allen, F. H. Appleton, Avery, Baker, Benedict, Blair, Bowditch, Brewster, Brooks, Bursley, Clark, Clemence, Cruickshanks, Damon, Ellsworth, Grinnell, Hall, Hersey, Horton, Kilbourn, Pratt, Raymond, Reed, Sargent, Sessions, Shaw, Smith, Stetson, Taylor, Wellington, E. E. Wood and E. W. Wood.

The records of the special meeting of the Board at Taunton were read and approved.

The executive committee, by Mr. Wood, chairman, reported the list of qualified members of the Board for 1898. The newly elected members are as follows: —

At large, appointed by the Governor: —
  DWIGHT A. HORTON of Northampton.
Elected by the societies: —
  Barnstable County, JOHN BURSLEY of West Barnstable.
  Blackstone Valley, SAMUEL B. TAFT of Uxbridge.
  Franklin County, FREDERICK L. WHITMORE of Sunderland.
  Hampshire, GEORGE P. SMITH of Sunderland.
  Massachusetts Society for Promoting Agriculture, NATHANIEL I. BOWDITCH of Framingham.
  Martha's Vineyard, EVERETT ALLEN DAVIS of West Tisbury.
  Middlesex North, JOSHUA CLARK of Tewksbury.
  Oxford, J. W. STOCKWELL of Sutton.
  Spencer, J. ELTON GREEN of Spencer.
  Union, ALMON W. LLOYD of Blandford.
  Worcester North-west, Thomas H. GOODSPEED of Athol.
  Worcester South, C. D. RICHARDSON of West Brookfield.

The committee further reported that all the incorporated societies except the Hampden and the Worcester North were entitled to representation on the Board; the Hampden Society having been ruled out last year for failure to comply with the law regulating representation on the Board and not having taken necessary action to remedy its delinquency, the Worcester North Society by its financial statement appearing not to have the required capital stock to entitle it to representation the present year.

The report of the committee was accepted and adopted.

Voted, That, recognizing the activity and usefulness of Mr. George Cruickshanks as a member of the Board from the Worcester North Society, the courtesy of the use of the floor be extended to him during the progress of this meeting.

An abstract of the annual report of the secretary was presented and accepted.

Voted, That the Chair appoint a committee of three to report resolutions on the death of Atkinson C. Varnum of Lowell, a member of the Board who has passed away during the past year. The Chair appointed Messrs. E. W. Wood, Kilbourn and Cruickshanks.

At 1.15 p.m. the Board adjourned to 2.30 p.m.

Board called to order at 2.30 p.m., Second Vice-President Wood in the chair.

The secretary presented a letter from Hon. Alvan Barrus, a member of the commission appointed to inquire into the expediency of revising and amending the laws of the Commonwealth relating to taxation, accompanied by a copy of the report of the said commission for each member of the Board.

Voted, That the thanks of the Board be extended to Mr. Barrus for his thoughtful consideration of the members of the Massachusetts Board of Agriculture.

The records of the executive committee, acting for the Board, were read by the secretary and approved, and the actions of the committee were adopted as the actions of the Board.

Mr. Kilbourn, for the committee to report resolutions on the death of ATKINSON C. VARNUM, reported as follows: —

Whereas, Since the last annual meeting of this Board ATKINSON C. VARNUM of Lowell, one of the oldest members of the Board in consecutive service, has passed away, —

Resolved, That this Board has lost one of its most valued and honored members; that the Middlesex North Agricultural Society has lost a long-time supporter and efficient officer; that the State which profited by his honesty and sagacity as a legislator and the country whose military service he entered in the dark days of rebellion and war have lost an honest and patriotic citizen; that the community in which he dwelt has lost a large-hearted friend, whose first aspiration was to do good as he had opportunity.

Resolved, That the family of our deceased friend and fellow-member has our warmest sympathy in the loss of a wise, considerate and loving husband and father.

Resolved, That these resolutions be spread upon the records of the Massachusetts Board of Agriculture, and that the secretary be instructed to send a copy to the family of Mr. Varnum.

After remarks by Messrs. F. H. Appleton, Sessions, Brooks, Hersey, Clark, Cruickshanks, Bursley and Stetson, the resolutions were adopted by a rising vote.

The report of the librarian was read by the secretary, was accepted by vote of the Board and will be found printed in this volume.

The committee on agricultural societies, by Mr. Kilbourn, chairman, presented a written report, which was accepted and adopted, and will be found printed in this volume.

The committee on domestic animals and sanitation, by Mr. Damon, chairman, reported that no matters had been referred to the committee, and it had not held a formal meeting during the year. The report was accepted.

The report of the committee on gypsy moth, insects and birds was presented at the special meeting of the Board at Taunton, Dec. 7, 1897, and was accepted and adopted by vote of the Board at that time.

The report of the committee on Dairy Bureau and agricultural products was presented by the committee and read by Mr. Geo. M. Whitaker, the assistant executive officer of the Dairy Bureau, which report was accepted and adopted, and will be found printed in this volume.

The report of the committee on Agricultural College and education was read by Mr. George Cruickshanks, chairman, and by vote of the Board was accepted and adopted as the report of the Board to the Legislature. The report will be found printed in this volume.

The committee on experiments and station work, by Professor Brooks, chairman, presented a written report, which was accepted and adopted, and will be found printed in this volume.

The committee on forestry, roads and roadside improvements reported verbally by Gen. F. H. Appleton, chairman, that no matter had been referred to the committee and that it had held no formal meeting during the year, but that the chairman had attended meetings of societies and associations devoted to forestry matters, and had represented the Board at such meetings. The report was accepted.

Voted, That it shall be the duty of each of the standing committees to hold at least one formal meeting each year, and to make a written report to the Board at the annual meeting.

At 4.45 P.M. the Board adjourned to 10 A.M., Wednesday.

SECOND DAY.

The Board met at 10 A.M., Mr. WOOD in the chair.

Present: Messrs. Allen, F. H. Appleton, Baker, Benedict, Bowditch, Brewster, Bursley, Clark, Damon, Ellsworth, Goodspeed, Green, Grinnell, Hall, Hersey, Horton, Kilbourn, Lloyd, Pratt, Raymond, Reed, Richardson, Sargent, Sessions, Shaw, F. H. Smith, Geo. P. Smith, Stetson, Stockwell, Whitmore, E. E. Wood and E W. Wood.

The records of the first day were read and approved.

Voted, That the by-laws be amended by inserting in the seventh line of Article I., after the word "committees" the words "*Provided*, that each appointed or elected member ot the Board shall be assigned to one of the committees, and that the members in excess of the thirty-five necessary to fill the committees be assigned to certain committees by vote of the Board at each annual meeting."

Voted, That the two members over the number necessary to fill the committees be assigned one to the committee on domestic animals and sanitation and one to the committee on Agricultural College and education.

Election of officers being in order, ballots were taken, and the elections resulted as follows: —

President, *ex officio*, His Excellency Governor ROGER WOLCOTT.
First vice-president, JAMES S. GRINNELL of Greenfield.
Second vice-president, ELIJAH W. WOOD of West Newton.
Secretary, WILLIAM R. SESSIONS of Hampden.

The chairman announced the following standing committees (the secretary is by rule of the Board a member *ex officio* of each of the standing committees): —

Executive committee: Messrs. E. W. Wood of West Newton, W. A. Kilbourn of South Lancaster, Isaac Damon of Wayland, D. A. Horton of Northampton, E. A. Harwood of North Brookfield, Edmund Hersey of Hingham and Francis H. Appleton of Peabody.

Committee on agricultural societies: Messrs. W. A. Kilbourn of South Lancaster, Q. L. Reed of South Weymouth, N. W. Shaw of North Raynham, O. P. Allen of Palmer and N. B. Baker of Savoy.

Committee on domestic animals and sanitation: Messrs. Isaac Damon of Wayland, F. H. Smith of Ashfield, O. S. Thayer of North Attleborough, F. L. Whitmore of Sunderland, Joshua Clark of Tewksbury and A. W. Lloyd of Blandford.

Committee on gypsy moth, insects and birds: Messrs. E. W. Wood of West Newton, Augustus Pratt of North Middleborough, F. W. Sargent of Amesbury, S. S. Stetson of Lakeville and N. I. Bowditch of Framingham.

Committee on Dairy Bureau and agricultural products: Messrs. D. A. Horton of Northampton, J. L. Ellsworth of Worcester, C. D. Richardson of West Brookfield, C. B. Benedict of Egremont and E. E. Wood of Northampton.

Committee on Agricultural College and education: Messrs. E. A. Harwood of North Brookfield, John Bursley of West Barnstable C. K. Brewster of Worthington, Wesley B. Barton of Dalton, J. W. Stockwell of Sutton and Geo. P. Smith of Sunderland.

Committee on experiments and station work: Messrs. Edmund Hersey of Hingham, Walton Hall of Marshfield, J. S. Grinnell of Greenfield, T. H. Goodspeed of Athol and J. Elton Green of Spencer.

Committee on forestry, roads and roadside improvements Messrs. F. H. Appleton of Peabody, S. M. Raymond, of Hinsdale, J. S. Appleton, Jr., of Nantucket, E. A. Davis of West Tisbury and S. B. Taft of Uxbridge.

Which appointments were approved by the Board.

Election of specialists being in order, ballots were taken and the election resulted as follows: —

Chemist, Dr. C. A. Goessmann of Amherst.
Entomologist, Prof. C. H. Fernald of Amherst.
Botanist and pomologist, Prof. S. T. Maynard of Amherst.
Veterinarian, Prof. James B. Paige of Amherst.
Engineer, Wm. Wheeler of Concord.
Ornithologist, E. H. Forbush of Malden.

Mr. Wesley B. Barton of Dalton, who was appointed to present an essay on "Opportunities of New England Farmers," being detained by sickness, his essay was rea

by the secretary, was accepted and will be found printed in this volume.

Mr. F. W. SARGENT read an essay on "Farmers' Institutes," which was accepted and will be found printed in this volume.

The committee on Agricultural College and education, by Mr. Bursley, reported recommending that the next public winter meeting be held at Amherst, on invitation of the Hampshire Agricultural Society and the faculty of the Massachusetts Agricultural College.

Voted, To accept the report, and that the next public winter meeting be held at Amherst, Dec. 6, 7 and 8, 1898.

Voted, That the chair appoint a local committee of arrangements, to act with the secretary and the committee on Agricultural College and education. The chair appointed Messrs. H. H. Goodell, G. P. Smith, D. A. Horton, E. E. Wood and F. L. Whitmore.

Mr. Bursley, for the same committee, reported recommending that Messrs. Brewster and Bowditch be appointed to present essays at the next annual meeting of the Board.

Voted, To accept the report, and that Messrs. Brewster and Bowditch be appointed essayists. Mr. Brewster announced his subject as "The Massachusetts Agricultural College: its criticisms; its benefits." Mr. Bowditch stated that he would announce his subject later.

Voted, That Mr. J. G. AVERY of Spencer be invited to address the Board.

Mr. AVERY gave an account of the three farmers' congresses he had attended as delegate, and stated that he had personally invited the congress of 1899 to meet in Boston, and suggested that the Board adopt the following resolve: —

Resolved, That the Massachusetts State Board of Agriculture extends an invitation to the Farmers' National Congress to hold its session in Boston in 1899, provided the Legislature makes an appropriation to defray the necessary expenses, not to exceed twelve hundred dollars.

On motion of General Appleton, the resolve was adopted.

Voted, That the matter be referred to the executive committee.

At 12.25 P.M. the Board adjourned to 2.30 P.M.

The Board was called to order at 2.30 P.M., Mr. WOOD in the chair.

The records of the forenoon session were read and approved.

Voted, That a committee of two be appointed, to consider and select a badge to be adopted, to be worn by the members at the public winter meeting of the Board, and while on duty as inspectors. The chair appointed Messrs. F. H. Appleton and Walton Hall as the committee.

Voted, That the hour for the annual meeting to be called to order be 11 A.M. instead of 12 M., as in the past.

The secretary reported the delinquencies of certain societies in making required returns.

Voted, To refer the matter to the executive committee, with power to excuse the delinquency, if in the opinion of the committee a reasonable excuse is given.

In consideration of the fact that the secretary, when accepting the office to which he had been re-elected, had stated that he should not expect or accept another re-election, and that, as the present election was for the year from July 1, 1898, to July 1, 1899, the Board might expect his resignation of the office to take effect either at the close of the next annual meeting or at the end of the month of January, 1899, and that the resignation would be presented in time to be acted upon at the next annual meeting, it was

Voted, That the secretary be requested to withdraw his notice to the Board that he declines to be secretary after July 1, 1899.

The following preamble and resolution was presented, discussed and unanimously adopted: —

Whereas, It has come to the knowledge of the Massachusetts State Board of Agriculture that the Massachusetts Society for Promoting Agriculture has granted the sum of twenty-five hundred dollars annually for five years to the Arnold Arboretum, to be expended by that institution in paying the expense of an investigation of trees and the best methods of their propagation, and has also granted the sum of one hundred dollars to the Massachusetts Agricultural College, to be expended in prizes to the students in the dairy school of that institution in the year 1898, —

Resolved, That the Massachusetts State Board of Agriculture assembled in annual meeting recognizes the generous financial aid granted to agricultural institutions and to plans for agricultural improvement by the Massachusetts Society for Promoting Agriculture from time to time during the past century, and now unanimously tenders the thanks of the Board to that society for the liberal grants described in the preamble to this resolution.

Voted, That matters of legislation concerning agricultural interests be referred to the executive committee, with power to appear before the committees themselves, or to appoint certain members of the Board to assist before committees of the Legislature.

Voted, That the recommendation of the librarian in his report, that a catalogue of the library be prepared, giving titles, authors and customary items, be adopted, and that the catalogue be published in the "Agriculture of Massachusetts" which is published next after the completion of the catalogue.

Voted, That the matter of increase of the salaries of the assistants in the office of the secretary be referred to the executive committee, with power to act.

Voted, That the librarian's report, read and accepted yesterday, be now adopted.

The committee on agricultural societies, by Mr. Kilbourn, chairman, reported recommending that the date for the commencement of the fair of the Hampshire Agricultural Society be changed to the second Thursday after the first Monday in September, that of the Oxford Agricultural Society to the

first Thursday after the first Monday in September, that of the Weymouth Agricultural and Industrial Society to the fourth Thursday after the first Monday in September, and that of the Worcester North-west Agricultural and Mechanical Society to the second Wednesday after the first Monday in September.

Voted, To accept and adopt the report of the committee, and to change the dates as recommended.

Mr. Kilbourn, for the same committee, reported recommending the assignment of inspectors, as follows: —

Amesbury and Salisbury, at Amesbury, September 27, 28 and 29, ...	T. H. Goodspeed.
Barnstable County, at Barnstable, August 30, 31, September 1, ...	F. L. Whitmore
Berkshire, at Pittsfield, September 13, 14 and 15,	F. H Smith.
Blackstone Valley, at Uxbridge, Sept. 27 and 28,	Geo. P. Smith.
Bristol County, at Taunton, September 20, 21 and 22, ...	C. D. Richardson.
Deerfield Valley, at Charlemont, September 15 and 16, ...	O. S. Thayer.
Eastern Hampden, at Palmer, September 20 and 21, ...	W. B. Barton.
Essex, at Peabody, September 20, 21 and 22, .	E. A. Davis.
Franklin County, at Greenfield, September 22 and 23, ...	S. S. Stetson.
Hampshire, at Amherst, September 15 and 16, .	E. A. Harwood
Hampshire, Franklin and Hampden, at Northampton, October 5 and 6, ...	Q. L. Reed.
Highland, at Middlefield, September 7 and 8, .	Edmund Hersey.
Hillside, at Cummington, September 27 and 28, .	S. B. Taft.
Hingham, at Hingham, September 27 and 28, .	E. W. Wood.
Hoosac Valley, at North Adams, September 21 and 22, ...	W. A. Kilbourn.
Housatonic, at Great Barrington, September 28 and 29, ...	Isaac Damon.
Manufacturers' Agricultural, at North Attleborough, August 30 and 31, ...	J. E. Green.
Marshfield, at Marshfield, August 24, 25 and 26, .	Joshua Clark.
Martha's Vineyard, at West Tisbury, September 20 and 21, ...	E. E. Wood.
Massachusetts Horticultural, at Boston, October 4 and 5, ...	N. I. Bowditch.
Middlesex North, at Lowell, September 15, 16 and 17, ...	S. M. Raymond.

Middlesex South, at Framingham, September 13, 14 and 15,	WALTON HALL.
Nantucket, at Nantucket, August 31 and September 1,	O. P. ALLEN.
Oxford, at Oxford, September 8 and 9,	AUGUSTUS PRATT.
Plymouth County, at Bridgewater, September 14, 15 and 16,	J. L. ELLSWORTH.
Spencer, at Spencer, September 22 and 23,	F. H. APPLETON.
Union, at Blandford, September 14, 15 and 16,	J. S. APPLETON, JR.
Weymouth, at South Weymouth, September 29 and 30 and October 1,	N. B BAKER.
Worcester, at Worcester, September 6, 7 and 8,	N. W. SHAW.
Worcester East, at Clinton, September 15 and 16,	F. W. SARGENT.
Worcester North-west, at Athol, September 14 and 15,	J. W. STOCKWELL.
Worcester South, at Sturbridge, September 15 and 16,	C. B. BENEDICT.
Worcester County West, at Barre, September 29 and 30,	A. W. LLOYD.

The report of the committee was accepted and adopted.

Voted, That the thanks of the Board be unanimously presented to the first and second vice-presidents for the able and pleasant manner in which they have performed the duties of presiding officer.

The records of the afternoon session were read and approved.

Adjourned at 3.45 P.M.

WILLIAM R. SESSIONS,
Secretary.

Report to the Legislature of the State Board of Agriculture, acting as Overseers of the Massachusetts Agricultural College.

[P. S., Chap. 20, Sect 5, adopted by the Board, Jan. 11, 1898.]

To the State Board of Agriculture, Overseers of the Massachusetts Agricultural College.

In compliance with the by-laws of this Board, the committee on Agricultural College and education has visited the college from time to time during the year, attended the examination for the Grinnell agricultural prizes, and was present at the commencement exercises. The prizes were awarded as follows: first, to Liberty Lyon Cheney, Southbridge; second, to Philip H. Smith, South Hadley Falls.

The Farm.

The following farm crops were grown on the college farm this season: Japanese millet, 4½ acres; field corn, 7 acres; celery, 1¼ acres; potatoes, 12 acres; corn for silage, 22½ acres; soja beans, 3 acres; oats and pease, 1 acre; beets, half an acre; carrots, 1 acre, — the last two, however, proving total failures from excessive moisture. The total cost of growing these crops was $2,000.06, charging the crops for one-half the manure and three-fourths the fertilizer applied. The value of the crops obtained is estimated to be $2,895.60, — all, with the exception of the field corn, soja beans and roots, being grown at a profit over cost of production.

There were 79 acres in grass, yielding 236 tons of cured hay and rowen and 74 tons of soiling crops fed green. Six acres of potatoes, grown on grass and clover sod, yielded

903 bushels of merchantable tubers, worth $722.40, the cost of production being $308.02; balance in favor of crop, $414.38. Six acres of potatoes, following onions and roots, yielded 463 bushels of merchantable tubers, worth $370.40, the cost of growing being $257.25; balance in favor of crop, $113.17, this field being somewhat injured by rot. A comparison of the two fields shows a difference of $300 in favor of those grown on grass and clover sod.

The 22½ acres of corn grown for silage yielded 287 tons, at a cost of production of $2.42 per ton. An excellent illustration of the effects of drainage was shown in the corn field. An area of about half an acre on one side of the field, not having been underdrained, yielded only at the rate of 4 tons of silage per acre, while the average of the balance of the field was over 15 tons per acre.

The celery crop again proved successful this season, 1¼ acres being grown, at a cost of $254.30, the value of the crop obtained being $400. The heavy rains caused much extra cost in the production of all the crops, but they were kept free from weeds.

The live stock are all in good, thrifty condition, a fine herd of grade calves being grown this season and many of the poorer milkers of last season's herd sold to the butcher, only those showing a balance on the right side being kept. Two fine-grade Percheron colts have been trained and worked this season, and proved a valuable addition to the working force.

Tools and Machinery.

No new tools have been added to the farm equipment this season, all there appearing to be in excellent order and well fitted for the uses required of them.

Improvements.

The only important improvement this season has been the moving and fitting for use as a cow barn of the shed formerly used at the State Experiment Station for sheep. The total cost of the same, including the farm labor, was $300. More or less student labor is continually employed at the farm, thus giving the students the opportunity to

observe and assist in practising what is taught them in the class room.

A hasty examination of the dormitories was made, and we note that new bath-rooms and closets have been constructed at North College, and that the rooms in both North and South colleges were generally comfortably furnished. As a few students may suffer from lack of means, it is suggested that, if certain necessary articles were provided for each room, the pupils of limited means would be better able to compete with their more fortunate companions. The reading room at North College is furnished by the students with the leading periodicals and newspapers at a trifling cost. The drill hall and armory next claimed our attention, where everything was found bright and shining.

The Hatch Experiment Station of the Massachusetts Agricultural College.

The field work in the several departments has suffered, like the farm crops, from the excessive rainfall during the summer months. This has demonstrated the necessity of more underdrains, which have been put in during the late autumn. The laboratory connected with the chemists' department has been completed, and several changes and improvements made in connection with the same. It would seem advisable that an appropriation be made for the construction of a small vegetation house, to be used in conducting fertilizer experiments. Electric lights have been introduced in the barn used by the director in charge of the department of foods and feeding. Experiments have here been carried on in feeding milch cows and pigs, to determine the comparative value of the various feeds which are by-products from the cereal factories. Here also digestion experiments have been conducted with sheep, to determine the amount of protein it is advisable to feed.

Veterinary Department.

In view of the fact that at the present time so much veterinary science is required to keep our farm animals up to the required standard, we recommend that more attention be paid to this department, it now being taught in the senior year only.

Department of Zoölogy.

The work in this department begins in the winter term of the sophomore year, with human anatomy and physiology, the study of which not only serves as an introduction to the more advanced work later in this department, and in veterinary science, but also gives the young men a knowledge of the structure and uses of the different organs of the human body and the laws of health. In the fall and winter terms the members of the junior class take zoölogy, which is taught by means of lectures and laboratory work. In the laboratory each member of the class dissects and studies a series of typical animals, making drawings of the various organs. During the spring term of this year a course of lectures is given on insects in general, their classification and habits and the various methods of destroying those that are injurious. There is a most excellent museum connected with this department, in which are exhibited, as far as possible, all the animals that occur in this Commonwealth, together with such species from other parts of the world as are necessary to give completeness, or are useful for the instruction of the students. This museum furnishes specimens for illustration in the lectures before the classes, and also for general information to all visitors as well as members of the college.

During the senior year such members of the class as elect advanced entomology take a course of more technical lectures, in which the following subjects relating to insects are considered quite at length: external and internal anatomy, embryology, transformations, duration of life, luminosity of insects, the color of insects, parasitic insects, diseases of insects, number of insects in existence, geographical and geological distribution, insect architecture, fertilization of plants by insects, economic entomology, bee-keeping and the literature of insects. The laboratory work of this year consists in part of the dissection of a caterpillar, a pupa and a moth, and a critical study of the external anatomy of a number of each of the orders of insects, followed by the exercise of determining a group of insects in each order; and, finally, each student is required to prepare a thesis on some insect or group of insects pertaining to the business in which he intends to engage. Each member of the senior class who

elects entomology is asked what business he intends to follow after graduation, and he is then advised to prepare his thesis on those insects with which he will most have to deal in the business of life. In the preparation of this thesis the work is carried on in the most approved method, so that he may obtain the most thorough scientific and at the same time practical knowledge of the subject; in fact, he is taught methods of investigation, so that, if new insect pests should appear on his crops, he will know how to properly investigate them and discover the best and cheapest methods for their destruction. If this thesis proves to contain matters of public interest, whether of an economic character or otherwise, it is published with whatever illustrations are necessary.

Economic entomology is divided, for convenience, into insects injurious in the greenhouse, in the garden, in the orchard, in the field, in the forest, to domestic animals, household pests, and the science and practice of bee-keeping. Instruction is also given on insecticides and apparatus for the application of insecticides. As the laboratory is in the same building with the insectary, all the members of the class have the opportunity of frequently inspecting the various experiments on different insects in this department of the Hatch Station.

This department is now prepared for and is receiving graduates from this and other colleges who wish to continue the study of entomology beyond what they were able in their undergraduate courses. These advanced studies will fit them for positions in the experiment stations or as State or government entomologists, and also give them most excellent training as teachers in our high schools and colleges.

Botanical Department.

The botanical museum contains a large collection of models of fruit and specimens of all the woods found indigenous to Massachusetts, and also the Knowlton Herbarium, the gift of the late William Knowlton of Upton, numbering over ten thousand specimens of plants from nearly all parts of the world. Last winter the Legislature appropriated $1,200 for an extension of the botanical laboratory. This extension

was greatly needed, for there was not room enough in the old building to accommodate the students in this department. With this appropriation the laboratory has been extended eighteen feet, a new ventilating apparatus has been put in, and the laboratory has been remodelled throughout, which is a great improvement. The laboratory is now capable of accommodating thirty-four students.

The course of study in botany remains the same as in recent years. One feature may be mentioned in connection with the sophomore work, — more attention has been given to the study of grasses, trees and shrubs. For this purpose representatives of most of our grasses, trees and shrubs are accessible to the students.

Station Work.—Some of the same problems which have occupied the attention of this department during the last two years are still being investigated, such as the drop on lettuce, top burn, and nematode worms in tomatoes, cucumbers and violets. The commercial growers are looking to the State Experiment Station for remedies for these troubles. The great importance of these investigations may be seen when we learn that the estimated value of the cucumber crop alone grown under glass is one million dollars, and the percentage of loss caused by insect and fungous diseases is from twenty-five to thirty per cent, which amounts to from two hundred and fifty to three hundred thousand dollars a year to the growers. Experiments are continuing with the tomatoes, for the purpose of finding out which is the best way to hasten the maturity of the fruit, and with different quality of glass for certain crops in the greenhouse. Experiments are also being made on the mechanical condition of the soil for lettuce. Extensive improvements have been made in the greenhouses for growing plants for the experiment work of this department. There are now three separate houses, so that each can be heated so as to suit the class of plants to be grown. The conditions in these houses are now as complete as it is possible to make them, and experiments can be carried on on a large enough scale to draw conclusions from.

Horticultural Department.

In making our report of the condition of the horticultural department of the college, we are pleased to observe that on the whole this department is in better condition than ever before. That portion of the Clark estate north of the reservoir has been fitted for a commercial orchard by ploughing under a heavy crop of rye in June, a crop of oats and peas in August, and a crop of barley and peas now lies on the ground, which will prevent washing during the winter, and will be turned under next spring. A young orchard of the most important new varieties of the apple, pear, peach, plum and cherry was set out in April, 1897, and made a good growth. All new varieties of both large and small fruits, as well as ornamental trees, shrubs and plants of very decided promise, have been procured and planted in the experimental plots and on the college grounds.

A collection of seedling grape vines originated on the grounds show much promise in vigor of growth, but have not fruited sufficiently to show their quality or time of ripening. A collection of seedling raspberries from choice seed of the hybrid purple-cap "Shaffer" show a great many types, from the black cap through to the vigorous red raspberry. A large collection of seedling red currants are of much interest, and some five hundred strawberry plants have been tested for two years, and many of them compare favorably with many of the new kinds, but further trial is needed to prove if any of them have merits superior to the named varieties. The new species and varieties of raspberries from the Pacific coast and other countries, the Loganberry, mayberry, salmon-berry, strawberry, raspberry, muskberry and wineberry have been planted, and some fruit may be expected the coming season.

The collection of ornamental trees and shrubs, probably the best connected with any agricultural college in the country, is being increased each year. They are planted on the plan that the entire grounds should be more or less decorated; and a very small sum expended for this purpose each year will soon result in a beautiful and useful park, with specimens of all the choice deciduous and evergreen trees and

shrubs, which will be of great value to the students in landscape gardening and to all lovers of choice trees and shrubs.

Important changes have been made in the greenhouses on the college grounds. The roof of the lower octagon has been raised and altered to the same size as the upper octagon, and the low roofs of the two Hatch greenhouses have been replaced by one large roof, which is a great improvement.

In 1876 the Massachusetts Agricultural College was in an embryonic state. Gov. Alexander H. Bullock, in his address to the Massachusetts Legislature, said: "By an act of the Legislature approved May 26, 1866, an immediate connection is created between these two institutions [referring to the State Board and the college]; and there seems to be no doubt that, with the influence of the Board binding it to every agricultural society in the State, and thus to almost every farm, the college may become not only the receptacle of a great amount of useful practical knowledge, but also the source whence the highest light of science may be shed to guide the farmer in his calling. For more than three-quarters of a century Massachusetts has been awakening to the necessity of agricultural education, by the thought and effort of some of her ablest thinkers and wisest statesmen; and she is entitled to a well-organized agricultural college, which shall form a part of her great system of university education, which shall combine and direct all her efforts for agricultural improvement, and shall be the special object of her kindest and most generous care as an important instrument in the work of popular cultivation. Under its present management, which is pervaded with harmony, earnestness and a wise spirit of economy, I predict the success of the institution."

These words were uttered as a prophecy. To-day it is different, — the success of the Massachusetts Agricultural College is an established fact. Yet its work needs to be carried to the people by every representative of the State Board. A large proportion of the soil of our Commonwealth is not used for profitable purposes to-day. It has been exhausted and become useless under old methods. In former days the soil yielded her increase with a generous hand. Now it is different. The successful farmer must study the

secrets of nature. Along with the changes of soil come changes of methods. Invention and machinery have largely supplanted physical force. Men must cultivate their minds and skill more than then, or they will not be abreast of the times. Success means work in newer and different channels. "Schools ought to be fitted to the requirements of humanity," said a noted German philosopher. We think the Massachusetts Agricultural College comes as near this as any school in the State. Practical knowledge and experimental work go hand in hand with theory and ethics. The student not only sees beauty in the flower, but also in the processes that bring it to perfection. He comes closely in touch with nature. The influence of this educational and experimental work cannot be measured by its curriculum or number of graduates. It reaches out in a thousand different ways. Not a farm or meadow, not a hilltop or valley in this State but what has, directly or indirectly, felt its magic touch, or received some benefit from its work.

In conclusion, your committee would reiterate what it expressed in substance in last year's report, — its wish that the people of Massachusetts interested in agricultural pursuits might come in closer touch and become more familiar with the work of this institution, which is especially for them.

"The riches of the Commonwealth
Are strong, free minds and hearts of health;
And more to her than wealth or gain,
The cunning hand and cultivated brain."

Respectfully submitted,

GEORGE CRUICKSHANKS.
E. A. HARWOOD.
JOHN BURSLEY.
C. K. BREWSTER.
W. B. BARTON.

REPORT OF COMMITTEE ON AGRICULTURAL SOCIETIES.

[Adopted at the Annual Meeting, Jan. 11, 1898.]

The committee on agricultural societies respectfully report that they have examined in detail the reports of all the inspectors of the fairs held in the State.

Whatever society held a fair, which deserved the commendations, and was not subject to the criticisms, contained in all these reports, was indeed a model society and in excellent condition.

By careful consideration of these several reports, we find very few which speak of objectionable features; and we believe that more care has been exercised by the officers in excluding from the grounds and vicinity of the fairs objectionable shows, fakirs and attractions. We think the lines can be drawn still closer, with advantage to all concerned, and that many of the cane boards and other devices for gathering money might reasonably be ruled out. Several reports criticise the sanitary arrangements provided, and we hope improvement will result.

Besides what is indicated in the reports, we find anxiety among almost all the societies for the outcome of each year's fair, and in many cases a loss of money, which every year causes some society to apply to the Board for approval of a mortgage. The problem which the societies yearly have to meet is not yet solved.

They have to arrange for a fair, instructive, attractive and creditable, and of necessity to incur large expense, and yet to depend very much on favorable weather for a successful financial result. We can only advise to keep down the expense as well as they can, by earnest effort and labor among their own members.

The approval of mortgages and sale of land seems to your committee to be too readily granted. They believe it was the purpose of the law, in requiring such approval, that the Board of Agriculture should interpose delay, in case action is taken by a society, without full consideration, or against the wishes of a considerable minority, or in case of sale of large property. We believe it to be the duty of the Board to make sure that it is the purpose of the society to use the proceeds of such sale in the interests of agriculture.

Respectfully submitted,

W. A. KILBOURN.
N. W. SHAW.
Q. L. REED.
O. P. ALLEN.
N. B. BAKER.

REPORT OF COMMITTEE ON EXPERIMENTS AND STATION WORK.

[Adopted at the Annual Meeting, Jan. 11, 1898.]

The committee of the Board of Agriculture on experiments and station work has the honor to report that one meeting of the committee has been held in Amherst, on the grounds of the Agricultural College, during the year. Owing to the absence of the chairman of the committee during the earlier portion of the year, the meeting was not held until November 9, — a date too late to give much opportunity for inspection of field experiments, which also is desirable. Unless, however, more than one entire day can be devoted to such a meeting, it will be found impossible to make even a superficial acquaintance with the work of the experiment station in all its branches. Your committee was early on the ground and devoted the entire day to the work, and yet, even with the omission noted above, found itself constantly obliged to hurry more than it wished in order to cover the ground laid out.

The programme of the day consisted in meeting in succession each of the heads of departments of the station — seven in number — by appointment in the office or laboratory especially devoted to his work, listening to a brief statement of the nature and results of recent work and a discussion of future plans. Since the reports of the officers of the experiment station accompany and comprise a part of your report (Agriculture of Massachusetts), it does not appear either necessary or desirable to summarize the facts elicited here.

It suffices to say, in conclusion, that members of the committee present expressed themselves as greatly interested in what they saw and heard, as well as much impressed with the scope and importance of the work of the station.

Such meetings must prove highly useful in promoting more sympathetic relations between the Board and station, in extending a knowledge of the station and its work, not alone among the members of the Board but throughout the general public through these members; and they should prove helpful to the station as well through suggestions and criticisms offered by members of the committee.

For the committee,

WILLIAM P. BROOKS,

Chairman.

REPORT OF THE LIBRARIAN AND CURATOR.

[Adopted at the Annual Meeting, Jan. 12, 1898.]

To the Secretary of the State Board of Agriculture.

SIR:—It is provided in article 3 of chapter III. of the by-laws of the Board of Agriculture, that "the secretary shall appoint one of his clerks librarian and curator, who shall act under his directions."

The appointment of the present incumbent of this office was made Feb. 6, 1894, since which date as much attention has been given by him to the building up of the office library as circumstances would permit.

HISTORY OF THE LIBRARY.

The State Board of Agriculture was established by an act of the Legislature of 1852, and was assigned rooms in the basement of the State House. Books of reference began to accumulate, and soon the nucleus of an office library was formed. The first reference to such a library, in the volume known as the "Agriculture of Massachusetts," is in the secretary's report for 1857; the reference being as follows: "The agricultural library connected with the office of the secretary of the Board has now become the largest and most valuable collection of the kind in New England, and is probably the most extensive in the United States. A complete catalogue* is to be found in the Appendix, and is now published for the use of those who are active in creating similar agricultural libraries in the various towns of the Commonwealth."

* This catalogue describes 844 volumes, 692 of which constituted the library proper, 125 the library of the Massachusetts Society for Promoting Agriculture, and 27 belonged to the secretary of the Board, and were on deposit for public use under the same regulations as the office library.

The next reference is found in the secretary's report for 1860, and reads thus: "The State Agricultural library, connected with my office, has received many valuable accessions during the past year, and is now one of the largest, if not one of the best selected, agricultural libraries in the United States. The collection of works on the honey-bee is believed to be the best and most extensive in the country."

Secretary Flint again refers to the library in his report for 1864, in the following language: "It is more generally used for reference than ever before, especially during the sessions of the Legislature, and it is important that some permanent fund should be provided by which the new publications should be procured as they appear."

Again, in 1865, the secretary says that "the library connected with the office of the secretary has gradually but constantly grown, till it has become the best, with very few if any exceptions, to be found in the country. It is of great service to the public, more especially during the sessions of the Legislature, when it is largely used for consultation and reference."

During the past thirty years the library has continued to grow in size and quality, until at the present time it contains 2,700 bound volumes, many of them rare and valuable, covering a wide range of subject matter, as will be seen by reference to the divisions as outlined in this report, and so classified and arranged on the library shelves as to be of the greatest service possible.

In this portion of the report it is desired to call attention to the following item, which for many years has been printed in the Manual for the General Court: "A valuable agricultural library, connected with the office of the secretary of the Board of Agriculture, is also open at all hours of the day for the use of the members of the Legislature."

Classification of the Library.

The library is separated into three divisions: I., publications of the United States Department of Agriculture; II., Experiment Station publications; III., general library.

Division I.

This division comprises bound volumes of the publications of the United States Department of Agriculture. The system of classification and indexing is that prepared by Miss Hasse, and the index cards now number 240. This division now consists of 126 volumes, classified as follows: —

Office of the Secretary,	Annual reports,	48
	Messages and documents,	2
	Special reports (old series),	3
	Farmers' bulletins,	1
	Special reports (unnumbered),	4
Bureau of Animal Industry,	Annual reports,	8
	Special reports,	6
	Bulletins,	2
Division of Botany,	Contributions United States national herbarium,	1
	Special reports,	1
Division of Chemistry,	Bulletins,	3
Division of Entomology,	Reports United States Entomological Commission,	5
	Bulletins,	2
	Insect life (index),	7
	Special reports,	2
Office of Experiment Stations,	Experiment Station record,	7
	Bulletins,	3
	Miscellaneous bulletins,	1
Division of Forestry,	Bulletins,	1
Office of Fiber Investigations,	Reports,	1
Division of Ornithology and Mammalogy,	Bulletins,	1
Office of Road Inquiry,	Bulletins,	1
Division of Statistics,	Monthly reports,	5
	Miscellaneous reports,	1
	Special reports,	1
Division of Vegetable Pathology,	Journal of mycology,	3
	Bulletins,	1
Division of Agrostology,	Bulletins,	1
Weather Bureau,	Special reports,	1
	Bulletins,	1
Division of Publications,	Bulletins,	1
Miscellaneous Reports,		1

Besides these volumes there are a number of pamphlets issued by the above-mentioned and other divisions of the department, and the effort is constantly being made to secure missing numbers.

Division II.

This division comprises bound volumes of annual reports and bulletins issued from time to time by the agricultural experiment stations of the country. The 143 volumes now in this division may be classified as follows: —

Maine,		1	Texas,	1
Vermont,		6	Missouri,	1
Massachusetts,	State,	6	Kentucky,	2
	Hatch,	3	Ohio,	10
Rhode Island,		2	Indiana,	1
Connecticut,	State,	4	Illinois,	2
	Storrs,	2	Iowa,	2
New York,	State,	14	Michigan,	3
	Cornell,	6	Wisconsin,	10
New Jersey,		13	Minnesota,	3
Pennsylvania,		11	South Dakota,	2
Maryland,		2	Kansas,	2
Virginia,		1	Nebraska,	8
West Virginia,		2	Colorado,	2
North Carolina,		7	Wyoming,	1
South Carolina,		1	Utah,	2
Florida,		1	Oregon,	1
Alabama,		3	California,	3
Louisiana,		2		

Besides these volumes there are many unbound bulletins and reports of the above-named and other States, which will be bound as soon as missing numbers can be secured.

A subject index of the literature of agricultural experiment stations and kindred institutions is supplied by the Office of Experiment Stations of the United States Department of Agriculture. This index, so far as completed, is now in use in the library room, and at the present time there are in the card catalogue case 14,800 cards, covering years 1887–95.

Division III.

This division comprises the larger portion of the library, and is sub-divided into eight classes, as follows: —

			Number of Volumes.
Class	I.	Agriculture, reports,	885
	II.	Agriculture, theory and practice,	268
	III.	Horticulture,	242
	IV.	Domestic animals,	204
	V.	Natural sciences,	227

		Number of Volumes.	
Class VI.	Statistics,	198	
VII.	Education,	192	
VIII.	Miscellaneous,	184	
			2,400

These classes are again sub-divided into sections, as follows: —

Class I. Agriculture, — Reports.

		Number of Volumes.	
Section 1.	Reports, boards of agriculture, etc.,	371	
2.	Transactions agricultural societies,	268	
3.	Proceedings farmers' institutes,	13	
4.	Crop reports,	3	
5.	Grange proceedings,	4	
6.	Reports, dairy associations, etc.,	24	
7.	Reports, produce exchanges, etc.,	11	
8.	Agricultural journals,	191	
9.	———	–	
			885

Class II. Agriculture, — Theory and Practice.

Section 1.	General works,	111	
2.	Manures and fertilizers,	20	
3.	Drainage and irrigation,	20	
4.	Farm implements, machinery, buildings,	18	
5.	Soils,	5	
6.	Crops, field,	40	
7.	Market gardening, vegetables,	17	
8.	Milk, butter, cheese,	7	
9.	Bees and bee keeping,	30	
			268

Class III. Horticulture.

Section 1.	Transactions horticultural societies, etc.,	69	
2.	General works,	4	
3.	Floriculture, flowers,	27	
4.	Forestry, arboriculture,	41	
5.	Landscape gardening, rural architecture,	31	
6.	Plants, propagation, diseases,	5	
7.	Greenhouses, construction and management,	3	
8.	Grapes and grape culture,	7	
9.	Fruits, orchard, small,	55	
			242

Class IV. Domestic Animals.

Section 1.	Cattle, breeds, herd books,	46
2.	Cattle, general works,	38
3.	Veterinary science, animal diseases,	46
4.	Sheep and wool,	21
5.	Swine,	3
6.	Horses,	33

		Number of Volumes.	
Section 7.	Poultry,	11	
8.	Dogs,	3	
9.	Cats, rabbits,	3	
			204

Class V. Natural Sciences.

Section 1.	Botany, plants,	35	
2.	Chemistry,	40	
3.	Geology,	17	
4.	Zoölogy, natural history,	31	
5.	Insects, injurious, beneficial,	57	
6.	Fish and fish culture,	5	
7.	Birds,	29	
8	Climate, weather,	13	
9.	———	-	
			227

Class VI. Statistics.

Section 1.	Agriculture,	8	
2.	Manufactures,	13	
3.	Labor,	37	
4.	Transportation,	28	
5.	Census reports,	48	
6.	Finance,	29	
7.	Taxation,	11	
8.	Public health,	16	
9.	Miscellaneous,	8	
			198

Class VII. Education.

Section 1.	Reports, boards of education, etc.,	15	
2.	Reports, educational institutions,	16	
3.	Encyclopedias,	47	
4.	Dictionaries,	19	
5.	History,	38	
6.	Biography,	4	
7.	Political economy,	9	
8.	Hand books, atlases,	20	
9.	Almanacs, calendars,	24	
			192

Class VIII. Miscellaneous.

Section 1.	Law,	60	
2.	Roads and bridges,	7	
3.	Journals, Senate and House,	16	
4.	Reports, Smithsonian Institution,	37	
5.	Unclassified scientific,	8	
6.	Scrap books,	4	
7.	———	-	
8.	———	-	
9.	General miscellany,	52	
			184

Pamphlets.

In addition to the bound volumes referred to, there is in the library quite a number of pamphlets on various subjects, many of which pamphlets are of considerable value. As yet no special classification has been attempted, other than to separate them according to subject matter and place them in the drawers under the book shelves. It is thought, however, that some of these pamphlets may be advantageously bound in volumes.

Current Publications, — Exchanges.

Certain daily newspapers, also papers and magazines published in the interest of agriculture, horticulture, forestry, etc., are received and are kept on file on the large table in the library room. The library is the recipient almost daily of publications from one or more institutions represented on the exchange list.

Among the countries represented in the library by their publications are England, Scotland, France, Italy, Germany, Switzerland, Austria, Prussia, Belgium, Denmark, Sweden, India, Japan, Canada and the Provinces, British Columbia, Mexico, Colombia, Porto Rico, Hawaii and Brazil.

Some Old Books.

The oldest book in the library is "The Booke of the English Husbandman," printed in London, and bearing the date of 1635. In the back part of this book are a number of pages describing "The Pleasures of Princes, or, Good mens Recreations." Some of the other older books are: —

"Observations in Husbandry." Edward Lisle. London, 1757.

"Museum Rusticum." 6 vols. London, 1764.

"Illustrations of Natural History, — Exotic Insects." D. Drury. 3 vols. London, 1770–82

"Ellis's Husbandry." 2 vols. London, 1772.

"A Treatise on Cattle." John Mills. London, 1776.

"Flora Scotica." John Lightfoot. 2 vols. London, 1777.

"Observations on Certain Parts of the Animal Œconomy." John Hunter. London, 1786.

"Husbandry of the Ancients." Adam Dickson. 2 vols. Edinburgh, 1788.

"The Botanic Garden" Darwin. 2 vols. London, 1791.

"The New England Farmer: or, Georgical Dictionary." Samuel Deane. Worcester, Mass., 1797.

Massachusetts Library Club.

The library of the Board is represented in the Massachusetts Library Club, the present librarian having become a member of the club very soon after his appointment.

Additions.

Additions to the library are made from time to time by gift, by purchase, by exchange and by binding pamphlets and similar publications. The expenses thus incurred are paid from the annual appropriation for "incidental expenses in the office of the secretary." The expenses for the calendar year 1897 were as follows: books and pamphlets purchased, $111.38; current publications subscribed for, $37; binding, $33; library supplies, $16.50; total, $197.88.

Future Work.

The removal of the office of the Board of Agriculture to rooms in the State House extension has enabled the librarian to place the volumes forming the library in suitable bookcases, and to arrange and classify them in a manner to make them easier of access and consequently of more value for reference than was possible in the former rooms of the Board.

Now that the books are so arranged and classified, the matter of a card catalogue of subjects becomes of importance. It must be evident to all that, if the library is to be made of the greatest use possible, the matter contained therein must be made readily available. The librarian knows of no better way to do this than by the use of a card catalogue of subjects. There is no question in his mind, speaking from an experience of over ten years, as to the great value of the library in the regular work of the office, for the need of it for reference purposes alone has been recognized from the very first, and its growth in size and range of subjects has resulted largely from the demands which have been made upon it. Furthermore, in his opinion the time has come to card catalogue by

subjects; for he believes that such a catalogue, properly made, will be of inestimable value in the future to all users of the volumes.

To prevent the accumulation of a large number of perhaps unnecessary cards, and to make the system as simple as possible, the librarian recommends the following: —

Books to be catalogued in the following manner: —

AGRICULTURE; the new, or the waters led captive. A. N. Cole. Book. New York. 1885. 223 pp. Illustrated.

WATERS led captive, agriculture; the new, or the. A. N. Cole Book. New York 1885. 223 pp. Illustrated.

The first card to be put in the case under the letter A and the second one under the letter W. The subject matter of chapters in a book may be indexed if found desirable. Also, if desired to number the books in the library, it would be a very simple matter to add the appropriate number to the card.

A lecture, essay or similar paper in a volume to be entered on cards thus: —

AGRICULTURE, the future of New England. Lecture. George W. Atherton, LL.D. State College, Penna. Agriculture of Massachusetts 1896, pps. 92–119.

NEW ENGLAND agriculture, the future of. Lecture. Geo. W. Atherton, LL.D. State College, Penna. Agriculture of Massachusetts 1896, pps. 92-119.

The first card to be put in the case under the letter A and the second under the letter N.

Finally, a reference to a particular subject in a book or paper to be entered on cards thus: —

BIRDS of Maine, list of. Agriculture of Maine 1861, pps. 113-122.

MAINE. Birds of, list of. Agriculture of Maine 1861, pps 113-122.

The first card to be put in the case under the letter B and the second under the letter M.

In order that the public, especially those persons who would be particularly interested in the office library, may know what the volumes are which comprise the said library,

it is recommended that there be prepared for publication in the "Agriculture of Massachusetts" a catalogue, giving titles, authors and other customary items. It is thought that such a catalogue would prove of value to interested parties.

Before leaving this subject of "future work" and as illustrative of ways in which the librarian may work, it is desired to call attention to the book prepared by him, and printed in 1893, entitled "Agriculture of Massachusetts,— Synoptical and Analytical Index, 1837–92." It was prepared because of a seeming need of a comprehensive index to the fifty odd volumes known as the "Agriculture of Massachusetts," and constituting in themselves a valuable agricultural library.

Also there are in process of compilation by him copies of all the laws and resolves of the Commonwealth relating to agriculture, horticulture, etc., and to the organizations having those interests in charge. This work has already received a good start, and the librarian now has in his keeping copies of the following: —

1. Agricultural and horticultural societies, acts of incorporation, amendments, etc. 1792–1860.
2. Agricultural and horticultural societies, general laws. 1819–60.
3. State Board of Agriculture. 1852-60.
4. Commissioners on Contagious Diseases of Domestic Animals. 1860-*
5. Massachusetts Agricultural College. 1863-*
6. Massachusetts Agricultural Experiment Station. 1882-95.
7. State Dairy Bureau. 1891-*
8. Miscellaneous agricultural laws. 1780-1860.

The plan is to bind the sheets containing these copies and place them on the library shelves. To this compilation there might some time be added the appropriations made and the amounts actually expended.

It has also been thought that it would be profitable for the librarian to have in his keeping a directory of the agricultural and kindred organizations of the country having the title "National," "State" or their equivalents, with name and

* Dates when established.

address of the executive officer, location of office, and reference to law under which the organization was chartered or incorporated.

During the past year, as in former years, considerable has been done along the line of supplying back volumes of the "Agriculture of Massachusetts" to libraries of societies and institutions, and quite a number of desirable publications have been received in exchange. Also duplicate publications have been supplied to teachers in public schools for use in class-room work. Along both of these lines it is thought the librarian may find a field for useful work in the future.

Conclusion.

The by-law of the Board already alluded to provides that "the secretary shall appoint one of his clerks librarian and curator." As it is thought the word "librarian" is sufficiently comprehensive, it is suggested that the words "and curator" be dropped.

It will be readily seen that the care of the library and the making of it as useful as possible along the lines suggested, and others, will require that the clerk holding the appointment of librarian give to this work as much time and thought as is possible, without neglecting his regular duties. This appointment is now held by the first clerk, and it would seem best that, all things considered, one person should be both first clerk and librarian. It is suggested, however, that the Legislature be asked to officially recognize this union of offices and duties by amending the act authorizing the secretary to employ a first clerk, and that it be also asked to establish a salary which shall be in proper proportion to the requirements and responsibilities of the suggested office of first clerk and librarian.

During the past year many requests for information along various lines have been received, and, by the help which the library affords, they have been answered as fully as possible. Also a number of persons have visited the office to consult the books. It is thought that when it becomes more generally known that there is in the office of the State Board of Agriculture such a valuable scientific library, and that it is so classified and catalogued as to be readily accessible, many

persons, particularly students and writers, will come to consult it or will write their desires to the librarian, and that the good results of the work of building up the library will become more and more apparent, and will be creditable to the Board of Agriculture.

Respectfully submitted,

F. H. FOWLER, B.Sc.,
Librarian and Curator.

Opportunities of New England Farmers.

BY WESLEY B. BARTON, DALTON.

I do not come before you to-day, gentlemen, prepared to tell you how *all* farmers can increase their incomes and improve their surroundings, but to make a few suggestions that will perhaps start a line of thought that will prove to be of some advantage either directly or indirectly in improving the surroundings and conditions of some of my brother tillers of the soil.

Opportunity is defined as a "fit time," "a chance." Now, do the farmers of New England take advantage of the fit times and chances offered them? Yes, some do, but many do not; some succeed, others make failures. And right here, what constitutes success in life? Is it riches or happiness? Last spring it chanced to be my lot to become acquainted with two old people, the grandfathers of a friend of mine, and I was entertained at the homes of both. One whose sole aim in life had been the accumulation of property was tottering on the brink of the grave, with scarcely a friend or acquaintance who could enjoy a visit with him. While he had succeeded in having broad acres and money at interest, when the time came to follow his mortal remains to their final resting place, the mourners were few and the tears were more of joy than grief. The other had lived a simple, quiet life, assisting many others in their efforts to battle with the world; and, although the cosy cottage where I was hospitably entertained was covered with a mortgage, and it was necessary for the sons and daughter to contribute to the necessary expense, there was happiness and comfort shown, and a contented spirit that is apparent only where life is a success.

Now, the New England man has every opportunity to make life worth living. Education can be had, social life enjoyed,

and success in finances will depend more or less on the success in the two mentioned; and, last but not least, that health and strength which the majority of New England farmers can enjoy if they only will.

In education we cannot all enjoy the benefits of our agricultural colleges obtained by taking a four years' course, but we can make occasional visits to those institutions of learning and experimental farms, and also the many typical farms perhaps owned by wealthy owners and managed by the hired overseer, but nevertheless worthy of careful investigation, and many lessons may be learned that will be of profit to the careful observer and student of nature. I have often had occasion to talk with an old man now past his four-score years. He had no chance to attend college, leaving school at twelve years of age, but he nevertheless was as well educated and better posted than fifty per cent of the college-bred men. How? By careful reading and close study of nature, nothing coming under his careful eye but what was diligently studied and reasoned out. And the farmer above all others has the opportunity to live close to nature and study how to reveal her wonderful secrets. Who among you has ever taken the kernel of corn and thought of the wonderful changes necessary as we place it in the soil, apparently a dead grain? But no! there is life. Soon the tiny blade appears, and then another and another; then the stalk and tassel and the ears appear; and the wind has assisted in one of the mysteries of nature, and the grain appears; and again we return to the original type of a kernel of corn. Who cannot find enjoyment in studying these wonderful processes of nature, which are constantly being repeated in this wonderful and beautiful world? Does the merchant, the manufacturer or the mechanic complete his work with the help of the Divine Being, or must he work out his problems wholly by the laws of mechanics?

On the farm there are constantly opportunities to improve the conditions. There is some little corner that is too wet, that needs a few rods of tile or an open ditch; a stump, that has been neglected and brush started around it, to be removed; or stone that we have banged our mowing machine against for several years; an old wall that is of no further

use; and many a little thing that costs but little time to do, careful not to neglect that place where only life can be enjoyed, — the home. Be sure wife, mother or sister has those little conveniences which are so fruitful in saving time and steps to those whose duties are many.

The most important spot on every farm is the garden, which should be planned to contain all those different vegetables enjoyed by the several members of the family; and one needs only to try, to realize how well you can supply a large family on a small area. My good father always wanted fruit of some kind on the table at meals, either in its natural or preserved state, and to that end all fruits were grown with more or less success; and to live without them would be a hardship indeed, and all these can be had with but little time and care if attended to properly. You can also adorn your homes with many a shrub and flower by using care at time of planting and pruning when needed. The better half enjoys this part of home adornments, which with the well-kept lawn helps to make the old homestead the favorite place for the boy and girl who are among the essentials to an enjoyable home on the farm.

What crops shall we devote our energy to? These of course we must adapt to our conditions. It would be folly to attempt to grow cranberries among the Berkshire hills to compete with our friends from Cape Cod. But our Cape Cod people would hardly be able to compete with Worcester County in the production of milk. And your distance from market shall also decide what crop or specialty will be most profitable for you to cultivate.

If the dairy is selected, study it carefully. Have a silo of sufficient capacity to give your cows at least one succulent feed per day, and add thereto such necessary feeds as will make a properly balanced ration, and not waste a part of your fodder for lack of proper assimilation. See to it that they have proper care and proper *stables*. The most successful dairy man is the owner who feeds and cares for them himself. I believe feed and care show better results than breeds. But select such cows for the dairy as will be sure to pay a profit over cost of keep, when that cost is given on an economical basis. Do not keep enough boarders to

use up the profits. The scales and Babcock test are a positive need on the dairy farm.

New England farmers can grow more of their nitrogenous foods in the shape of clovers, peas, soja beans, and, mixing with the corn in silo, greatly decrease the cost of necessary grain ration, and at the same time remove less of that most costly fertilizing element from the soil, namely, nitrogen, and with the careful saving of farm manures constantly improve the condition of the farm.

Market gardening near the large markets is one of the best openings for the farmer, but, like all other successful farm operations, must be grown into and special lines followed for success. In fruit growing there are many examples of what can be done both for those near to market and at some distance from same. The apple can be grown in all sections of New England, and seldom fails to show a profit over cost of production. The peach in some sections under proper conditions has proved profitable, and the demand for small fruits is considerable. Strawberries, raspberries and blackberries are always in demand in our markets, especially for No. 1 goods, and right here comes the point: whatever you have to sell, put it up in the best possible condition to market, as buyers of such goods look at the packages oftentimes as much as at the goods, and the extra cost thereof is more than doubly paid for, besides giving better satisfaction to the buyer.

The poultry industry is one of the opportunities too often neglected, and should be carefully cared for, even as a side issue, on every farm. I say side issue, for it is a business of itself, but can be profitably carried on in connection with other farm operations, especially fruit growing, and many examples of success are abundant in our Commonwealth. Here also, as in the dairy, careful selection, feed and detail work are the bone and sinew of success. And right here let me ask this question: Why not keep and grow an established breed for the purpose you wish them for, rather than the mongrel? Will not the Leghorn breed lay more eggs in a year than one of mixed breeding? Will not the dairy cow, be she Jersey, Guernsey or Holstein, the animal bred for a specific purpose, give you better results as a pro-

ducer of butter or milk than the animal of hap-hazard breeding? The lifetime of man is too short to attempt to perfect a breed of cattle, and success in that line has been largely the results of work under the direction of the governments; and then only the specific purpose attempted has been attained, although there are many men who have graded up a herd so as to double their production by the use of the pure-bred sire; but when they have attained their highest perfection they are largely the type of the breed selected for sires, and are bright examples of the opportunity offered to the enterprising breeder to develop a paying herd. And it seems to me that the raising of dairy cows is one of the branches of farming that will soon be as profitable as in former years, especially in sections where pasturage is abundant and cheap. Cows are now commanding good prices, and the tendency appears to be more and more in that direction. The separator which as a farm machine has come to stay will be found especially useful on the butter or cream raising farm, enabling the farmer to feed his calves the warm skim-milk, which, with the addition of a small quantity of flaxseed meal, makes an ideal ration, and good thrifty animals can be grown thereon; and thus can the skim-milk be used perhaps to better advantage than competing with cheap corn and transportation of our western brethren in rearing pork and placing pork products on the markets of the east.

There are some opportunities in regard to the social life of New England farmers that are not taken advantage of as they should be. First, the church, which every farm family should endeavor to take an active part in, not only attend its Sunday services, but also the mid-week meetings as well; and if the town you live in does not support your denomination, take part in the one it does support; and all the time the support will be amply repaid, perhaps not in dollars and cents, but with a feeling of satisfaction enjoyed only by those who have endeavored to do their share in making life's burdens more easy to bear.

The farmers' institutes held under the direction of this honorable Board are one of the opportunities that are neglected. Many a farmer might save himself many a day of labor, and money as well, by taking advantage of the

lectures and discussions following them; would know his neighbors better, and form acquaintances that would be lasting, and also give him some idea of the good emanating from the fairs held in the different sections of the State.

The grange is also a place well worthy of the attention of my brother farmers, both as to social and educational advantages; and many an awkward New England boy owes his success in life to the learning and ambitions awakened in the hospitable grange halls, where he was taught how to preside and to think and command language to express his thought in public; and many a farmer's wife and daughter have learned to look forward to the meetings, to which they are welcomed and which they enjoy with the husbands and brothers, — banquets which they alone know how to prepare. I hardly believe there is a New England town which needs the advice given to a western town by Henry Ward Beecher, who, on being informed that they were discussing the advisability of organizing a church or a grange, and being told that they could not agree as to what denomination to choose, replied: "Organize a grange; you can all preach there."

And one opportunity which has been taken advantage of in the past, and is ever open. No country has ever produced a better class of honest yoemanry than the tillers of the soil of old New England. She has produced men and women who have been an honor to her nation, and whose names are written in the history of our nation in letters so indelible as to never be erased.

Farmers' Institutes.

BY F. W. SARGENT, AMESBURY.

It was a wise piece of legislation when the Board of Agriculture made the rule requiring each incorporated agricultural society to hold each year three or more farmers' institutes.

The fairs held each autumn by the several societies we have long had the benefits and pleasures from, but much more recent was the establishing of a series of annual lecture meetings. Now these meetings or institutes are, in most cases, looked forward to by the progressive farmers with as much eagerness as are the fall fairs; and in my opinion they are, when properly conducted, capable of increasing an interest in practical agriculture.

Our societies are incorporated for what? For the promotion and advancement of agriculture; and the farmers' institutes, held during the winter months, the farmers' season of comparative quiet and rest, are, when properly managed, conducive to education, sociability and recreation. They are the means of bringing together leading representatives of the greatest business or occupation in the world, — that of food production, — to listen, to discuss and to compare notes regarding subjects near and dear to them in their every-day occupation.

There is not the excitement and bustle attending the meetings that characterize the fall fairs, but rather there is quiet, tone and dignity, educated and gentlemanly speakers, blackboard and chart illustrations, sometimes music and frequently appetizing lunches or hearty dinners, all of which combined make the institute days what they were designed for, — *i.e.*, to place the calling of agriculture on a higher educational level.

They are, I am certain, doing much good, and in many cases the abolishing of them would be a serious loss to the

community in which they have been held. They are a means of bringing out new methods and theories for discussion, and of bringing face to face agricultural teachers, and those who are pleased to be their pupils, if for only a day. They are a means of bringing us face to face with our favorite agricultural writers, those whom we have followed perhaps for years in the weekly papers, and often wished we could see them and hear from their own lips their words of wisdom. We have all enjoyed the pen work of such men as Cheever, Hoard, Bailey, Roberts, Twitchell, Gould, Collingwood and many others. Has it not been like meeting an old friend when we are permitted for the first time to see them before us on the lecture platform? The institutes have given us the opportunity.

My boyhood love for agriculture was intensified by the writings of the first-mentioned in the "New England Farmer," and when I was in position to put his teaching into practice, I found pleasure and profit in his methods of soiling cattle. Was it any wonder, then, that my first meeting with him at an institute was a pleasure to me?

Then at the institutes the farmer, especially the young man, gets in the habit of questioning the speakers, and after a little he finds himself taking part in the discussions, and the commencement made here leads to a future ability as a speech-maker. I remember my first question asked at an institute, with fear and trembling, and how the presiding officer, the venerable Benjamin P. Ware, held me by his peculiar ability as a chairman and his method of drawing one out, until I had made quite a little speech. He did me good, as he has scores of others in a similar way.

Arranging for Institute Meetings.

Although the number fixed by the by-law of the Board of Agriculture is three meetings a year, this is no reason why a society should limit them to this number, for twice this or more can be held to a profit by many societies. Still, there is a possible danger of overdoing even the institute work in some sections, and each society can best judge the number to be held to advantage.

Some societies hold an evening meeting; some a one-session daytime meeting; while the most common way is a forenoon and afternoon meeting, with time for lunch between. This latter way is the most advisable one, I think.

In order to decide upon the number of meetings to be held, where they shall be held, and the subjects for discussion, it is advisable for a committee on institutes to be appointed as soon after new officers are elected as possible, which committee shall have in charge all arrangements, including speakers and advertising. They should use care in selecting the place, that the greatest number may be accommodated; a light, well-heated and well-ventilated hall must be procured; if a place where dinners can be had at a moderate charge, it is well, but if this cannot be, the picnic plan of a lunch with coffee served by a local society or farmers' club answers the purpose well.

The committee should try to meet the wants of each locality in the selection of subjects; still, such subjects must be selected as will keep up an interest, and draw out questions and experience of those who attend. The most interesting part of an institute is often after the speaker is done with his manuscript or has finished his speech, and the meeting is thrown open for questions.

In some sections I would advise a meeting of three sessions, the third one to be in the evening, and more in line of a lecture, with or without a stereopticon, and where music and elocution can be mixed in, but without the discussions. One at least of our societies holds the institute only in the evening, when an oyster supper follows the discussion and a dance follows the supper. It is needless to say that this institute is well attended, and may be the best way for that society; but it is not my favorite way of "running" institutes, or one to be recommended.

Having decided what question to discuss, then the men — or women — for speakers should be selected. We at the present time are supplied with a goodly number to choose from. The secretary of this Board has prepared a list, from which the societies can select speakers. The list is a good one, one that has not been approached by any other State, so far as I am able to judge. It includes college professors

in all departments, agricultural editors, doctors, chemists and practical farmers, young men fresh from the colleges and old men of acknowledged reputation and world-wide experience. The list is each year increasing in number. Much credit is due our Secretary Sessions for the list of speakers. It is a benefit to a man to be on the list and to come in contact with the average farmer audience. Our college professors and editors recognize the fact, and the office and laboratory work go on the better after a day spent in such work, or recreation, if you please.

The list of speakers sent out by the secretary should not be the only source from which to select. Local talent can often be called in, and men of ability from neighboring towns can be selected, who for a trifling expense can be secured to furnish a lecture. A very interesting meeting last winter consisted of twenty-minute essays, from four or five representative farmers in the town where the meeting was held, all on the same subject; with the different views expressed by the speakers, the discussion which followed was a spirited one.

One or two good blackboards should be procured and placed in easy reach of the speakers in the hall, for the speaker can often illustrate his point by figures, diagrams and formulas better than by words, and the opportunity to do so should not be denied him. A table large enough for him to exhibit samples, photographs and models, is also necessary. Often I have seen this table left out of the hall furnishings entirely. Many speakers have charts illustrating their lecture, and a chance to hang them on the wall must be arranged.

Presiding Officer.

For the success of a meeting, much depends on the presiding officer or chairman. He should know the subject beforehand, and, if he is not familiar with it, he should post himself to some extent upon it; he should learn who in the locality are interested in that subject, and see that they are present to aid in the discussion. He should be a live, wide-awake and capable man, quick to see a point, to hear a question and to fill in any vacant moments. He should not

allow the meeting to drag or the interest to wane. With a good speaker and a bright chairman an interesting institute can be held, even though the attendance be small. But the attendance *must* not be small; and, if the committee and president or chairman do their full duty, the interest will increase with each meeting.

The Speakers.

To them I will not attempt to dictate, and will only throw out a few suggestions. Make your lectures so that all can comprehend them. Use plain English for the common people, for scientific terms are not easily understood or remembered. Use the blackboard and charts in illustrating points to be remembered. Show models and designs, if you would have a new tool or contrivance understood. I have known a man occupy ten minutes in trying to explain how a rude implement was made, when by a half hour's work at home he could have made a model that would have shown at a glance a better description of it than he was able to give verbally, and he would have had it for all his lecture work for the winter, besides. Bring, if need be, an animal onto the stage, as Dr. Twitchell does, to show the structural points. It is object lessons that accomplish the best results in our teachings.

That was a happy thought of Professor Fernald's in his lecture at Taunton, when he mixed before the eyes of the farmers present the new insecticide known as arsenate of lead. After seeing a thing done once, it is very much easier for one to attempt it than if only a verbal description be given.

Let our fruit men carry samples of fruit to exhibit at the meetings, our market gardeners can show selected vegetables, the dairymen fine samples of butter and cheese, and the housekeepers canned goods and cooking. The testing of milk with a Babcock tester has entertained many an audience, and will continue to do so. It should not be considered out of place for dealers to show new implements, seeds, feed-stuffs or fertilizing material at a meeting of this kind, any more than to advertise them in an agricultural paper, and such exhibits should be encouraged.

Now, a few suggestions that I have never seen attempted are practical for the coming institute season. There is, in my opinion, no reason why any careful man cannot apply to his cows the tuberculin test. Let our veterinarian instructors show by actual example just how this is done; take a cow into the hall, show how the physical examination is made, and then apply the test by injecting the tuberculin and instruct the farmers how to note the temperatures. It is not a difficult thing to do, and any bright man can do it for his own satisfaction, — at least after seeing it done once with the necessary explanation; and it may save him from buying diseased cows. Then mix and show the use of disinfectants in cleansing a stable, show the simplicity of these things, and the dairymen will be more ready to adopt them. Then I would like to see an illustrated lecture by a master mechanic, showing the use of tools of various kinds, and how to sharpen and care for them; the construction of difficult parts of buildings, machines and vehicles; practical lessons in fitting horseshoes, — and many other things which the farmer occasionally has to do for convenience, and might often do for profit.

Power of some kind in farm buildings — horse, steam, gasoline or electrical — will be an important factor in future farm operations, and a knowledge of such should be taught.

When our nursery and fruit men talk on their favorite subjects, I would have them show in comparison an ill-shaped tree and perfect ones, with methods of correcting the growth, as the New Hampshire advocate of forestry, Judge Lyman, does in his favorite theme, the pine tree. I would have them show with the knife how the roots and branches of a young tree should be prepared for planting; also how to propagate, bud and graft. These things are not all new, but, if they are worth talking about, they are better understood if so illustrated. Every farmer knows a plough, but some men will use one a lifetime, and still not know just how to adjust or hitch onto it correctly.

I am not trying to make out that the Massachusetts farmers are not intelligent, but rather that our institute speakers must work on advanced lines in order to entertain and instruct them. I believe we are well up to the times. Th

ancient plough is in many cases replaced by the riding or sulky plough; and, while I hardly think that the plough can ever be done away with, yet the single-furrow plough is too slow for the times. I hope to see an implement that will cut a furrow and pulverize it ready for planting at one operation, working to the desired depth and two feet or more wide. Some may smile at the idea, but such a tool would only be in keeping with our planting machines and harvesters.

I want to see our dairy cows all free from dangerous diseases, and all bred up to a fifteen per cent butter-fat standard.

It will please me to see on every farm general-purpose horses fitted for all farm work, and yet capable of showing a three-minute clip when hitched to the buggy. Some of my older friends here may not be satisfied with this method of travelling, however, and still look with eagerness for perfection in the horseless carriage. My sympathies are with the horse; and, although other methods of travel must be resorted to for convenience, yet for the greatest enjoyment the noble, well-cared-for and spirited horse, with a modern carriage, furnishes that peculiar pleasure which is invigorating and inspiring; and when our State has perfected her system of State highways so that we can drive from the seacoast to Berkshire comfortably seated in a carriage in which the mechanic's skill has perfected the comfortable upholstering, the elastic springs and the pneumatic tires, a sense of enjoyment equalled by none can be realized.

I want to see the free delivery of mails in every rural district for the convenience of the Massachusetts farmers; and the establishing of postal savings banks, that his children may learn to save their small accumulations, and his hired men may deposit their savings with the assurance that the receipts for the same are backed by the United States government.

And then, with the establishing of foreign markets for our crops and dairy productions, with fraudulent imitations of butter and cheese forced out of existence, with a knowledge of the proper use of the plant food in commercial fertilizers and an assurance of pure seeds and unadulterated feedstuffs

placed upon the market, — the farmer will find more time for educational and social features.

All these things I would have made subjects of lectures and discussions in our farmers' institutes; and if adopted, and co-operation with the granges and other organizations brought about, I am sure increased interest will result, and our meetings be what they were intended for, — to advance and promote agriculture and to help the common farmer along educational lines.

BULLETINS

MASSACHUSETTS BOARD OF AGRICULTURE,

PUBLISHED IN

MASSACHUSETTS CROP REPORTS, 1897.

SMALL FRUITS IN THE HOME GARDEN.

BY S. T. MAYNARD, BOTANIST AND POMOLOGIST TO THE BOARD.

Small fruits are pre-eminently the fruit for the home garden. They are easily grown, and do not require a large amount of land to produce a liberal supply of fruit for home consumption. The fruit can be put on the consumer's table in a fresh, ripe condition, quite unlike the fruit purchased from the market.

The increasing interest in fruit in the home garden and the numerous inquiries as to the best methods, fertilizers and varieties, have led to the preparation of this bulletin, in which the practice of the best growers is given briefly, modified so as to adapt it especially to the home garden.

THE STRAWBERRY.

The strawberry is perhaps the most important fruit in cultivation in the temperate zone, and especially as a home fruit, although it takes a leading place as a money crop for fruit growers in all sections of the country. In yield, measured in quarts or bushels, it will probably average through a series of years more than that of any other fruit crop. Reliable records have frequently been made of nearly one thousand bushels per acre, and with an average of from two hundred to three hundred bushels per acre under good average condition of cultivation, or one to two bushels per square rod. The strawberry possesses unusual importance, in that it is the first fruit to ripen in the summer, and is the one that gives the quickest returns to the grower after planting.

Conditions of Successful Growth.

The strawberry will succeed upon a variety of soils, but to reach the best results on a given soil, varieties must be selected that grow best on that soil. For most varieties,

however, the best soil is a deep medium loam, made rich by the addition of stable manure ploughed deeply under, and the surface well dressed with fine-ground bone and potash, or fine stable manure. An unfavorable soil may often be greatly improved at a little expense. If too heavy and moist, under-draining or the addition of sand will improve its condition; while if too light and dry, ploughing or spading under a heavy coating of stable manure or other organic matter will enable it to retain more moisture, without which a large crop cannot be produced. New land gives the best results, *i. e.*, that which has been in grass for many years; but it should not be planted with strawberries until some other hoed crop, like corn or potatoes, has been grown on the land one or two years, to avoid injury from the "white grub" or larvæ of the May beetle, which are generally found in such land and would continue feeding upon the roots of the strawberry when the grass roots have decayed.

Time for Planting.

The best time to set strawberry plants is as early in April as the land will work up fine and mellow. Never set plants in soil that will cake and dry into hard masses when pressed in the hand. Early in the season plants have but little foliage, the soil is moist and cool, evaporation is much less than when the foliage is large and the sun high, and plants are much more certain to grow than when set later. Summer and fall planting cannot be recommended when the best results are desired. If one has neglected to plant in the spring, it may be better to plant late than not at all, but little or no profit can be expected.

Setting the Plants.

Many persons fail to make strawberry plants grow, from setting them too deep, others from too shallow planting, and more from not pressing the soil about the roots firmly enough. The following figures illustrate these conditions: Fig. 1, the *proper depth;* Fig. 2, too deep, and Fig. 3, too shallow planting. A test of the proper firmness of the soil may be made by taking hold of the leaf of the newly set plant, and if it is properly firmed the leaf will break off, leaving the plant in

position, but if not the plant will be drawn out of the soil. No fruit should be allowed to ripen on the newly set plants the first season.

FIG. 2.

FIG. 1.

FIG. 3.

Distance for Planting.

There is a great diversity among practical growers in the distance at which the plants are set, and also under different conditions. On a very rich soil the plants may be set further apart than on thin soil, and it may vary under these conditions from one by three feet to four by five feet, using from twenty-five hundred to seven thousand plants per acre. In the garden where the soil is not very rich and where the plants are grown more or less in the hill or wide-distance matted row, even less than the smaller number may be set.

Method of Training.

Two general methods of training are practised, the hill and matted row, both of which are varied by different commercial growers, and admit of greater variation in the garden than in the field. The close matted row is where the runners are allowed to grow over all the space except where the cultivator runs between the rows. The modified or wide-space matted row is where only a limited number of the runners are allowed to grow, each plant having from four to six inches space for development. By the hill system the plants, put out in the spring, are not allowed to set any runners. The advantage of the first method is that the plants serve to protect each other during the winter, and a very large crop is often produced; but the plants do not have a chance to

fully develop, and the fruit will be of small size and inferior quality. In the modified or wide-space matted row each plant has space for perfect development, and the crop is large and of fine quality. This method is especially adapted to the home garden. With the hill system, no runner being allowed to grow, a large number of crown buds are formed and a large number of flower buds produced, but the plants are liable to become shallow-rooted and easily thrown out by the frost. If the plants are in hills, heavily mulched during the winter and during the fruiting time, fairly good results will be obtained, but not equal to those from the modified matted row.

Cultivation and Fertilization.

In fitting the land for the strawberry, the deeper it is worked, provided the subsoil is not brought to the surface, the better. Frequent stirring of the soil during the summer must be followed if the best growth is desired.

Fertilizers containing a large per cent of potash and phosphoric acid should be used for the production of fruit. Nitrogenous manures should be used sparingly, unless the soil is very poor, as they tend to the production of foliage at the expense of the fruit. A very good formula is from twelve hundred to two thousand pounds of fine-ground bone and five hundred pounds of potash per acre. Use one-half at planting, sown broadcast, one-quarter early in August and the balance early in April of the following year. If stable manure is used for a surface dressing in the spring, it should be well rotted and fine.

Winter Protection.

There are scarcely any conditions under which the strawberry crop is not improved by winter protection, for, although the strawberry plants are perfectly hardy and grow much farther north than this, in cultivated land the plants are liable to be thrown out by the frosts in the fall and spring, and some covering must be applied to prevent this. The materials most commonly used are coarse hay, straw, strawy manure, corn stover, pine boughs and pine needles, all of which are good.

If the cover or mulch is put on too early in the fall or too deeply, the plants will often be injured by heating, and for this reason the application is delayed until the ground is somewhat frozen. If the ground were covered with snow from December to April, little or no covering would be needed, but this is not often the case. Only a thin covering should be applied, just enough to shade the ground and prevent alternate freezing and thawing when there is no snow on the ground. When growth begins, the mulch may be removed, the land carefully cultivated until the fruit begins to approach maturity, when the mulch is put back to protect the fruit from the soil, or, as is the most common practice, left on the ground, and when the plants begin to grow, drawn away from the crown. The quantity and quality of the fruit are undoubtedly improved by the former method, but it is doubtful if it is more profitable.

Gathering the Fruit.

For home use the fruit should be allowed to become thoroughly ripe before picking, and the bed should be picked over every day. Even for the market the fruit can be allowed to become fully ripe, if it is carefully picked in the cool of the day, and is kept in a cool, dry place until it reaches the customers; and the problem of securing the local market to the grower would solve itself, if only perfectly fresh ripe fruit were offered to the consumers.

Best Varieties.

The varieties of strawberries may be divided into two groups, *i.e.*, "pistillate," those with pistillate flowers only, and "perfect," those having flowers with both stamens and pistils. The pistillate flowered varieties generally are more productive than those with perfect flowers; but, if the former are planted alone, no fruit will be produced, therefore some staminate or perfect-flowered varieties must be planted near them. The proportion of the two kinds that are generally planted is about three rows of the pistillate to one of the perfect-flowered kinds. Of the thousands of varieties that have been introduced within the past ten years scarcely a

half dozen have proved superior in all particulars to the old standard sorts, yet there has been considerable progress as to quality and size of berry. Some varieties succeed in one locality and not in another, and some on one kind of soil and not on another, so that it is very difficult to give a list of varieties that will succeed under all conditions. The best way for one to decide as to the best kinds to grow in a given locality is to consult successful growers in his own immediate vicinity. The list suggested that will probably give the best results under a great variety of conditions is as follows: Bubach (pistillate), Haverland (pistillate), Lovett (staminate), Leader (staminate), Clyde (staminate), Brandywine (staminate) and Parker Earle (staminate).

Annual Cropping.

It has now become the practice among the best growers to grow but one crop from a planting. The advantage of this is that it is easier to grow plants set in the spring up to fruiting, than to renew an old bed, the fruit is much finer and more of it, and a second crop of cabbages, beets, celery, etc., may be grown after the strawberry crop is harvested, so that two crops are produced in the two years. It allows also of more frequent rotation.

THE CURRANT.

No fruit is more highly prized during hot weather, is more healthful or more easily grown than the currant. It is a perennial fruiting shrub, and with proper care will continue producing fruit for a quarter of a century or more.

The Soil.

While the currant can be grown upon almost any soil, it succeeds best in a deep, rich, moist loam. It also succeeds under the shade of fruit and ornamental trees, provided an abundance of manure or fertilizer is used. The value of the fruit for market depends largely upon its size, and to produce large fruit a vigorous growth of the bushes must be produced.

Planting.

Early in the fall is the best time for planting currant bushes, though they succeed well if planted in the spring. No. 1 one-year-old plants are the best for planting, though No. 1 two-year-old plants are often used.

The distance at which they are planted varies somewhat with different growers and their mode of pruning. If the bushes are kept close pruned and are on a rather light soil, four by five feet is about the right distance; but if allowed to grow rather large and on rich land, four by six feet will be none too much space.

Cultivation.

A rich soil and clean cultivation must go together, for without the one the fruit will be of small size and without the other the weeds would soon choke out all growth of either the bushes or fruit.

Mulching.

No fruit is more benefited by an abundance of moisture than the currant, and a mulch of hay or coarse manure helps to keep in the moisture and the fruit from becoming soiled during heavy rain storms.

Pruning.

The currant produces its best fruit on strong, vigorous shoots, two or three years old, while that on the older wood is small and of inferior quality. It is therefore the practice in pruning to cut out all very old canes and encourage the growth of strong new shoots. This may be done at any time after the leaves have fallen, and before much growth in the spring, but the fall is the best time for this work.

Varieties.

There are many good varieties in cultivation, but they do not show so much variation as to form, size and color as the other kinds of fruit. Any of the leading sorts may be made to produce large fruit if grown in a rich soil and properly pruned. In fact, it is asserted by many that the only difference between many of the varieties is produced by cultivation

and fertilization. However this may be, it is conceded by the best growers that carefully selected plants of the several varieties do have distinct characteristics. Among the varieties most grown the best are the Cherry, Fay's Prolific, Red Dutch, Victoria and White Grape. The white currants are much less acid and of better quality than the red kinds, but are not so readily sold in the markets. The Victoria is said to be especially valuable, because of its hanging so long on the bushes after ripening. Three new varieties of very superior quality have recently been introduced, which will be of especial value for home use, if not for market; *i.e.*, Wilder and Pomona Red, and White Imperial, all of which are much less acid than the old sorts, and have a remarkably aromatic and delicious flavor.

Insects.

As with almost any crop on the farm or garden, the currant is injured by insects. The "currant worm" comes upon the bushes soon after the leaves begin to unfold, and in a few days destroys all of the foliage unless checked in its work. The best remedy is powdered hellebore, dusted over the bushes while the leaves are wet with dew or rain, or sprayed with water mixed at the rate of one tablespoonful of hellebore to a common two-gallon pail of water.

Fungous Diseases.

The failure of many a currant plantation to yield a profit has often been due to the leaves being destroyed by a leaf blight that first appears as small dots on the lower leaves. These increase in size and number, and soon cause the leaves to fall, preventing a full maturity of the canes and fruit buds. This injury is prevented by spraying with the Bordeaux mixture * just as the blossoms are set, and again as soon as the fruit is picked.

Red Raspberry.

The red raspberry is considered the most delicious of the small fruits. It brings the highest price in the market, and

* See Bulletin No. 44, Hatch Experiment Station.

is also the most perishable. In the home garden it can be grown to perfection and be put upon the grower's table in a perfectly ripe condition, in which condition it would be impossible to transport it even to a near market, and in this condition it has an aroma and freshness seldom found in the fruit purchased in the market.

The Soil.

The best soil for the red raspberry is a deep, sandy loam, that is not seriously affected by drouth. In thin soils mulching or irrigation must be practised to insure a crop in seasons of drouth. On a light soil the canes mature better than on a heavy one, and are less likely to be injured during the winter. This injury is prevented by laying down the canes in the autumn before the ground freezes.

Planting.

The fall is the best time to plant the raspberry. The canes should be cut back to six inches before planting, and then one or two shovelfuls of soil or manure banked over them.

The raspberry is grown in rows where the cultivator can be run but one way, or in hills where it can be run both ways. Both methods give good results, the distances being four by six or three by five feet, according to the vigor of the varieties.

Fertilizers.

As with the strawberry, a liberal supply of plant food is a necessity, and bone and potash are equally valuable for the raspberry, and about the same quantity must be used. If the soil is very light, one hundred to two hundred pounds of nitrate of soda per acre will be found valuable.

Cultivation.

No fruit is more benefited by frequent cultivation. This keeps the soil cool and moist, the condition under which it grows the best. In this work the only care needed is not to cultivate too deeply, or to destroy too many of the new

shoots as they come up in the spring; for it is better to have a surplus of canes to cut out at the fall or winter pruning than to have the land only partly stocked with canes.

Pruning.

The pruning the red raspberry requires for the best results is the pinching off the ends of the canes during the summer as soon as they are two and one-half feet high, which causes a branching, tree-like growth. The fruiting canes are also to be cut out as soon as the fruit has been gathered, and the laterals of the new growth to be headed in at any time after the leaves drop in the fall or before the beginning of growth in the spring. All very small canes should be cut out, as they produce only small fruit, and this being near the ground is so injured by dirt as to be of no value. The fruit also on the large canes is benefited by this thinning. When the pruning is completed, the strong canes should stand from *six* to *eight* inches apart, and the greater the number of these strong canes the larger will be the crop.

Renewing the Plantation.

Perhaps no fruit sooner exhausts the soil or the soil conditions under which it is profitably grown than the raspberry. The roots and suckers permeate the soil in all directions and after a few years the plantation must be renewed, or an increasing amount of plant food be applied. Six to ten years is about the limit of profitable growth in one place, when a new plantation should be started on fresh soil.

Varieties.

There are but very few varieties of the red raspberry that can be successfully grown under the average conditions and care. Of these, the Miller, Cuthbert, Loudon and Golden Queen will give the greatest satisfaction for home use or market.

Insects and Fungous Pests.

There are no insects that are seriously injurious to the raspberry under ordinary conditions, but a fungous known as the leaf blight often causes serious damage. This disease first appears as small, reddish spots, which soon increase in

size and number until the whole leaf is infested, when it turns brown and falls off, a few of the upper leaves only escaping; where this leaf blight comes on early it often so weakens the canes that the fruit is small and the plantation soon dies out. The remedy is spraying thoroughly with the Bordeaux mixture just before the blossoms open, and again as soon as the fruit has been gathered.

Winter Covering.

The canes of even the most hardy varieties are sometimes winter-killed and the crop seriously injured or wholly destroyed. This injury can be certainly prevented by covering the canes with soil in the fall just before the ground freezes. Only a light covering of soil is needed, just enough to hold the canes down to the ground. In the spring the canes should be uncovered as soon as the frost has come out sufficiently, for, if allowed to remain on the ground, they start into growth too early, and will not stand up as readily as if raised earlier.

The Black-cap Raspberry.

In a general way the black-cap requires about the same treatment as to soil, cultivation, training, pruning and fertilization as the red raspberry. It is considered less desirable for home use and less profitable for the market than the latter, but is more easily grown and produces a very much larger quantity of fruit. It also grows in hills, and does not give any trouble from suckers.

Planting.

The black-caps are propagated by the rooting of the ends of the canes in the fall, and should be set out only in the spring. Great care should be exercised in planting them not to set the "tips" too deeply, as the buds from which new canes will grow are liable to injury by deep planting. A very large per cent of the black-cap tips planted fail to grow from this cause. A mound or a ridge between two furrows is made, the roots are spread out with the bud on the highest part of the mound or ridge, the roots running as deeply into the soil as possible, and the soil is then pressed *very firmly*

about the roots and only *moderately firm* about the buds The bud of the tips should not be covered with more than a inch or two of soil, varying this with its character, but th roots should be well down in the moist soil. Planted in thi way, every "tip," if in good condition, will be sure to grow

Pruning.

The pruning, training, cultivation and fertilization require for the black-caps are the same as for the red raspberry, an spraying for insect and fungous pests should be the same.

Varieties.

As with the other small fruits, some varieties succeed i one locality or condition of soil and fail in others, and th same rule should be followed as with the strawberries in th selection of varieties. The varieties that will most generall succeed are the Souhegan, Cromwell, Ohio, Kansas, Gregg etc.

HYBRID RASPBERRIES.

A class of raspberries known as "purple caps" or "hy brids" are now considerably grown, and are especially valu able for the home garden, but on account of their color a of no value for market. In habit of growth they are like th black-cap, propagating by tips, but produce a fruit interme diate between the black-cap and the red raspberry in colo and of the substance and flavor of the latter, being considere even superior to either in quality. The plants of the vari ties now most grown are not quite hardy, the canes a generally more or less winter-killed, and are rather difficu to cover on account of the strong growth of canes; but, eve when the main canes are killed nearly to the ground, later shoots will often come out that produce a fair crop of fru When not injured, the crop is often enormous. Of t varieties most grown, the Shaffer and Columbian are t leading sorts. They are attacked by the same leaf blig that injures the red and black-cap raspberries, and shou have the same treatment.

The Blackberry.

This very healthful and delicious fruit is easily grown, produces a large crop, and, but for its habit of spreading over the garden, would be more generally planted. This difficulty, however, is easily overcome if all suckers that come up outside the prescribed limits of the rows or hills are treated as weeds, and are *pulled* up instead of being cut off at the surface as is the common practice. It should never be planted in the corner of the garden, where the suckers can run out into other land, but if possible in the centre of the garden, where it can be seen upon all sides.

Soil.

The soil it requires for its best growth is about the same as for the red raspberry, though it will succeed fairly well upon any soil, if not full of standing water. In a heavy undrained soil they are more likely to winter-kill than upon one of a sandy or gravelly nature, while upon the latter they need an extra amount of plant food.

Planting and Training.

The time of planting, method of training and pruning are the same as for the red raspberry. The distance at which they are planted varies from two to four by eight feet where they are to be grown in rows, to five by eight feet where they are to be grown in hills. In fertilizing the blackberry field or plot the same kind and quantity of fertilizer should be used as for the red raspberry.

Varieties, Insects and Diseases.

The varieties best adapted to the home garden or the field are the same, and the Agawam, Snyder, and Taylor's Prolific are certainly the best of those fully tested. No insects interfere seriously with its growth, but the fall and spring "orange rust" is often abundant and destructive. Spraying as for the raspberries will in a measure overcome it, but it is better also to cut out all rusted canes and leaves as soon as they appear.

Three Shade-tree Insects.

BY A. H. KIRKLAND, M.S., ASSISTANT ENTOMOLOGIST TO THE COMMITTEE ON GYPSY MOTH, INSECTS AND BIRDS.

The Sugar Maple Borer.*

One of the largest and most gaily colored beetles of our New England fauna is responsible for injuries of a most serious character to the sugar maple, a tree which, from beauty of form and as a source of sugar, justly holds a high place in popular estimation. The damage resulting from this beetle, commonly known as the sugar maple borer, shows itself in gnarled and distorted trunks, dying branches and, too frequently, in the gradual death of the entire tree. This pest is not a new one to this region, although its ravages appear to be most severe in more northern latitudes. The habits of the insect were first noticed and described by a New Hampshire pastor, the Rev. L. W. Leonard, who is quoted by Dr. Harris in his "Insects Injurious to Vegetation." The latter author gives an excellent description of the mature beetle. Other writers have given many interesting notes upon the habits of the insect, but perhaps the best account of the life history of this borer is that by Prof. A. S. Packard, in the fifth report of the U. S. Entomological Commission. From this article, as well as from the writings of Saunders, Bethune, Weed and others, the writer has drawn liberally in the preparation of this paper.

Life History.

The eggs are laid by the mature beetle on the trunks of sugar maples during the months of July and August. According to Packard, the beetle cuts obscure gashes in the bark and in them deposits the eggs. The eggs hatch in a short time and give rise to small white grubs, which "mine" the bark for a short distance before attacking the cambium

* *Plagionotus speciosus* Say.

layer of the tree. Soon, however, they burrow to the living wood and commence their work of destruction. Many borers feed only upon dead wood, but this insect apparently feeds only upon living wood. The burrows or grooves cut by the larvæ generally run upward, beneath the bark and partially around the tree, although it is not rare to find them running almost directly downward. These grooves follow very irregular lines, are about one-half inch in width by perhaps one-third inch in depth, and, by passing around a part of the tree, cut off the sap circulation in that part. Where the larvæ are abundant it is not an uncommon thing to find a tree entirely girdled by these grooves.

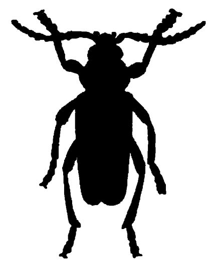


Fig. 1. The Maple Borer. (From Saunders.)

It seems probable that two years are required for the completion of the transformations of this insect. In examining a number of infested trees I have found several burrows entering the wood for an inch or two, half way in their course, then coming out to the cambium again and continuing to enlarge until the place for pupation is reached. From this it might appear that the larva is only partly grown when overtaken by winter and seeks shelter in the trunk at this time, as well as when preparing to pupate. In a recent letter Dr. A. S. Packard expresses the opinion that two years are required for the development of this insect.

Fig. 2. Trunk of a Maple attacked by the Maple Borer. (Original.)

When the larva approaches maturity it usually enters the trunk for a short distance and forms a chamber, within which it transforms to a pupa, from which, in midsummer, the mature beetle emerges. Under burlap bands placed on trees at Malden, Mass., to collect gypsy moth larvæ, I have found the mature beetles as early as June 24. The majority of the beetles, however, do not appear until July, during which month they may be occasionally found on the blossoms of goldenrods.

Dr. Harris describes the mature beetle as follows: "The beetle is black, with a yellow head, with the antennæ and the eyes reddish-black; the thorax is black, with two transverse yellow spots on each side; the wing-covers for about two-thirds of their length are black, the remaining third is yellow, and they are ornamented with bands and spots arranged in the following manner: a yellow spot on each shoulder, a broad yellow curved band or arch, of which the yellow scutel forms the keystone, on the base of the wing-covers; behind this a zigzag yellow band forming the letter W, across the middle another yellow band arching backwards, and on the yellow tip a black curved band and spot; legs yellow, while the under side of the body is reddish-yellow, variegated with brown, nearly an inch in length."

Nature of the Damage.

The cambium layer, the layer of living wood just beneath the bark, is the growing part of the tree and contains vessels which serve a function similar to that of the arteries and veins of an animal. The grubs or larvæ of the borer feed in the cambium and cut off the circulation of sap. This results in the death of the trunk near the burrows, the bark falls off and areas of dead wood are exposed to the disintegrating influences of the air. In the mean time, however, the tree attempts to overcome the injury by throwing out an additional growth at the wounded places, and thus the gnarled and unsightly trunks are produced. An early yellowing and falling of the foliage is another indication of the presence of the borer and betrays the weakened condition of the tree. The largest or so-called "first growth" maples are nearly exempt from the attacks of this insect, possibly because the roughness and thickness of the bark may prevent the beetle from depositing its eggs. Younger trees, with smoother bark, are frequently attacked, and upon such trees throughout the State the ravages of the beetle are apparently on the increase.

Natural Enemies.

As natural enemies of this insect it is probable that various species of woodpeckers render the greatest service. At Huntington, Mass., I have seen the hairy woodpecker, the

downy woodpecker and the flicker feeding upon white larvæ taken from beneath the bark of maples infested by this borer, — presumptive evidence that these birds feed upon this insect.

Remedies.

The application of remedial treatment for borers is generally attended with considerable difficulty, since the insects cannot be reached by insecticides, and in the case of the maple borer, as with many allied beetles, hand labor is the best means for destroying the pest. An examination of the infested trees in September will reveal small discolored spots on the trunks, showing where the larvæ have commenced feeding. Masses of fine brown castings are often found on these spots. By the use of a sharp knife the larvæ may be dug out and killed, while the burrows of the older larvæ should be followed and the inmates destroyed. All exposed wood, whether living or dead, should be thoroughly coated with a thick lead and oil paint, to exclude the air and prevent decay. Dead branches should be removed and the stumps painted. Where the trees are badly infested it may be advisable to prune severely, for with a limited and weakened sap circulation they cannot properly support the normal amount of foliage.

The preceding suggestions apply chiefly to the treatment of infested maples which serve as shade trees. In the case of an infested sugar orchard it would be impossible and impracticable to give the trees the same degree of care, and here the main dependence must be placed upon preventive measures. If one will take the trouble to look over a number of sugar orchards, he will find that the ones most affected by the borer are those in which the underbrush and smaller trees have been cut, and the writer would suggest that here we have an explanation of the increase of this pest in the sugar orchards of western Massachusetts. Brush and undergrowth in a sugar bush interfere with the gathering of sap at the season of sugar making, and the practice of "clearing up" sugar orchards is one growing in favor with the owners of the orchards. Where maples have grown with trees of other species, and with a thick forest cover, the trunks are usually free from branches to a considerable height. When

the forest cover is suddenly cut off and only the maples are left standing these trees soon become weakened, as a result of the altered conditions. It is a well-recognized fact that sickly trees are the favorite victims of borers of all kinds, and the maple is no exception to this rule. The clearing up of sugar orchards also allows the sunlight to penetrate to a greater extent than before, and the borers, being sun-loving insects, doubtless find a greater number of attractive places in which to lay their eggs. During the past five or six years the writer has had several opportunities to examine the sugar orchards near his home at Huntington and in other parts of western Massachusetts, and has seen repeatedly the clearing up of orchards followed by extensive damage by this borer, and is led to believe the matter is simply one of cause and effect.

Remedial measures may be briefly summarized as follows: for infested shade trees, cut out the borers in September, prune if necessary, and cover all exposed wood with thick paint. In sugar orchards, allow as much forest cover as is consistent with the work of sap gathering. In both cases cut all badly infested and dying trees and burn them before midsummer, thus destroying the insects they contain.

The Oak Pruner.*

From an entomological stand-point the summer of 1896 was marked by an unusual abundance of the oak pruner in

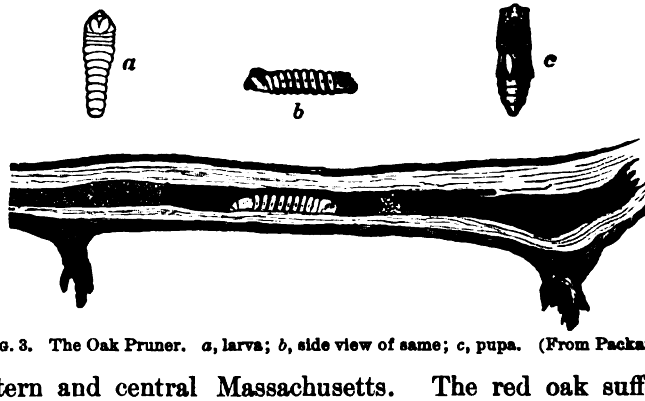


Fig. 3. The Oak Pruner. *a*, larva; *b*, side view of same; *c*, pupa. (From Packard.)

eastern and central Massachusetts. The red oak suffered most severely, but the white and scarlet oaks were not

* *Elaphidion villosum* Fabr.

wholly exempt from the ravages of this beetle, while in some cases the sugar and red maples and hickories were attacked either by this insect or by one of identical habits. The presence of the borer is shown by the falling of living branches which have been severed from the tree by a clean cut. By splitting the severed end of a fallen branch the insect causing the damage may be readily found,—a slender white or yellowish-white grub with black mouth parts.

Life History.

The eggs are said to be laid by the parent beetle in early summer upon the young growing lateral twigs, at a distance varying from a few inches to a foot or more from the main branch. Probably but a single egg is laid on each lateral twig. Upon the hatching of the egg the young grub or larva burrows downward in the twig, leaving but a thin shell of bark and wood. When the branch is reached a burrow is made beneath the bark for a short distance toward the trunk, and the branch is nearly cut off by the larva. The latter then retreats into its burrow, plugs it with chips and feeds within the branch. Winds soon break the weakened branch from the tree, and in the fallen branches the larvæ feed until fall, when the majority transform into pupæ from which the mature beetles emerge the following spring.

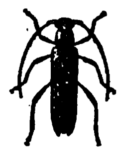


Fig. 4. Oak Pruner.*

Concerning the time occupied by this borer in passing through its various transformations there are many statements of a contradictory character. It would appear that the time may vary from one to four years, although the writer believes that one year is the rule in this region. Dr. Hamilton,† in his criticism of the writings of Peck, Harris and Fitch on this insect, states that in cases coming under his observation from three to four years were required for the development of the mature insect. In the summer of 1896 a number of branches infested by this insect, collected soon after falling from the trees, were placed in an out-door breeding cage at the insectary of the gypsy moth committee,

* Drawn by J. H. Emerton. † Canadian Entomologist, August, 1887.

Malden, Mass. From these branches, at the time of writing (June 12, 1897), the mature beetles are emerging, thus showing that the round of life may be completed in a single year and corroborating the statements of Fitch and other early writers concerning this point.*

Natural Enemies.

As natural enemies of the oak pruner Mr. F. H. Mosher records the downy wood-pecker, the blue jay and the chickadee. I have found a spider, determined by Mr. J. H. Emerton as *Theridium tepidariorum* C. Koch, feeding upon the mature insects.

Remedy.

Preventive measures are the only ones of value in combating this insect. The fallen branches should be gathered and burned at once, thus destroying the borers which otherwise might transform and appear as beetles the following year. A common mistake made by many property owners is that of gathering the infested branches and leaving them on some convenient rubbish heap. This procedure is worse than useless, since under such conditions the transformations of the borer are not hindered.

The Imported Elm Bark Louse.†

In cities and suburban districts the damage to young elms by this insect is a frequent and increasing cause of complaint, and while its life history has been so well treated by Lounsbury in Bulletin 28, Massachusetts Hatch Experiment Station, a brief statement concerning its habits and the remedies we have found effective in destroying it may be properly given at this time.

This insect is an imported bark louse, superficially resembling the "mealy bug," and is commonly noticed in the crevices of the bark on the trunks and branches of elms. The females are bordered with a mass of whitish wax and give birth to large numbers of young during the early part of

* Statements also vary concerning the time of the appearance of the mature beetles. In 1896 the majority of the beetles captured at Malden were taken in June. Mr. A. F. Burgess has taken specimens of this borer as early as April 11.

† *Gossyparia ulmi* Geoff.

July. The young lice migrate to the leaves and after feeding on the plant juices throughout the summer, return to the branches with the approach of cold weather and prepare to hibernate. According to Prof. L. O. Howard, the males appear late in May and the females give birth to the young in from three to four weeks from the time of pairing.

Food Plants and Damage.

The bark louse was probably brought to this country upon European elms. It occurs commonly on the Camperdown and Scotch elms and also inflicts serious injury to the American elm, the slippery elm and the cork elm. The greatest

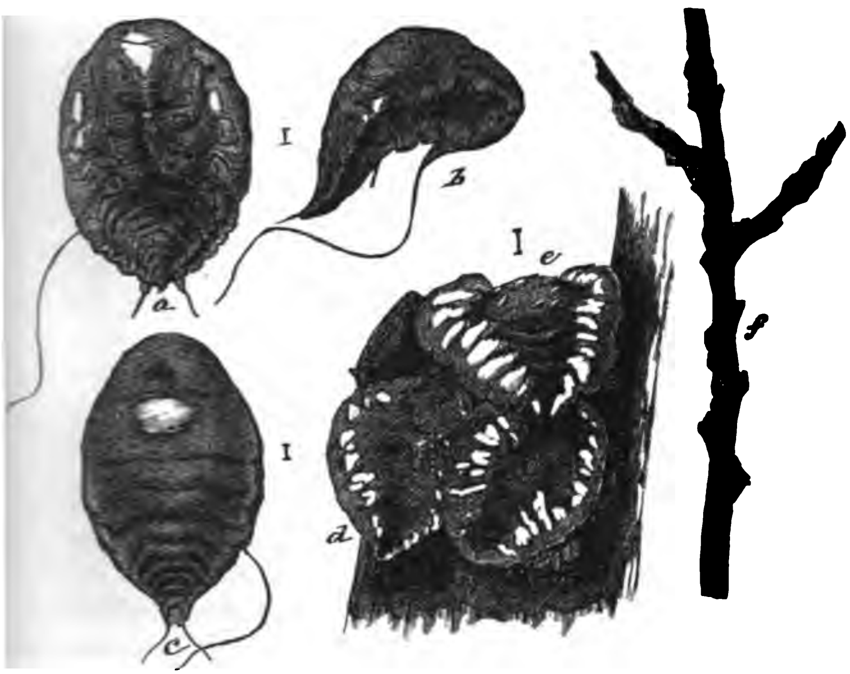


FIG. 5. The Elm Bark Louse. *a*, adult female from below; *b*, adult female from side; *c*, adult female from above — all greatly enlarged; *d*, empty wax cushion; *e*, females in natural position — enlarged; *f*, shrivelled females, natural size. (From "Insect Life.")

damage to elms from this insect occurs on young trees recently taken from the nursery. As factors in the dissemination of this insect, nurseries have played a most important part. In fact, the first complaint of damage from the elm bark louse was reported from a large nursery in New York.

Where large numbers of elms are grown in compact plots the insect appears to find most favorable conditions for multiplication, and it is a matter of the writer's personal observation that many of the large nurseries in this State where elms are thus grown are abundantly supplied with the insect. The elm bark louse is now generally distributed throughout Massachusetts, and may be considered a serious pest, since from the insidious nature of its attack it often escapes notice until the infested trees are injured beyond recovery. The presence of the insect is often indicated by an early yellowing of the foliage on the infested branches and the gradual death of the latter from the tip downward toward the trunk.

Remedies.

The damage from the imported elm bark louse is a long time in appearing and considerable time is required for the tree to recuperate from the injury. Badly infested trees should be pruned of all dead and dying branches in the fall, the wounds being covered with thick oil paint or gas tar. At the same time the trunk and branches should be scrubbed with strong kerosene emulsion, made by dissolving one-half pound hard soap in two quarts of hot water and stirring into the mixture while hot one gallon of kerosene oil. Dilute the emulsion with three parts of water and scrub the trunks and branches with this mixture, using a stiff brush. The following spring, top-dress the ground beneath the trees with good stable manure or with nitrate of soda, and later, in July, spray the foliage thoroughly with kerosene emulsion, diluted one part to nine of water. The recommendations given above apply to cases where the trees have been seriously injured. Where the insects occur in moderate numbers both the scrubbing and spraying may be done in July with satisfactory results. Often a thorough spraying at this time will suffice to destroy the greater part of the insects.

To show how cheaply this work may be done where a large number of trees are to be treated, the following account of the treatment of 3,000 young elms in Manning's nursery at Reading, Mass., may be of interest: In May, 1896, Mr. Manning found that the elm bark louse had multiplied to such an extent as to seriously infest a large part of his stock

of elms. At the writer's suggestion, these elms were scrubbed with strong kerosene emulsion and in July were thoroughly sprayed with the dilute emulsion. The cost of the work, taken from data kindly furnished by Mr. Manning, was as follows: labor, $18; kerosene and soap, $3; a total expense of $21, or 7 mills per tree. As a result of this treatment over ninety per cent of the insects have been destroyed; in fact, it would now be difficult to find a more thrifty lot of elms. This shows the comparative inexpensiveness of the remedy and the good results attending its thorough application.

WHY MILK SOURS, AND HOW THE SOURING CAN BE PREVENTED OR AT LEAST DELAYED.

BY GEORGE M. WHITAKER, A.M., ACTING EXECUTIVE OFFICER OF THE MASSACHUSETTS DAIRY BUREAU.

During the hot summer weather milkmen have much trouble with sour milk and there is especial complaint of the large amount of sour milk in Boston. In spite of the thousands of cans of surplus, when the pinch of a warm spell comes, the surplus is wiped out by the sour milk, and the contractors have hardly enough sweet milk to supply their trade. The same is true, though to a less extent, in other places. Now, this is unnecessary. So much is known about the causes of milk souring that any farmer can avail himself of this information and profit thereby. Sour milk is inexcusable nowadays, and here is one of the things wherein modern science has done much for dairying. The souring of milk is caused by the presence in it of bacteria, the tiniest forms of organic life known; no bacteria, no sour milk.

Milk in the udder of a healthy cow is free from bacteria, the germs of decay coming chiefly from the air. If milk could be drawn through a sterilized tube into an air-tight sterilized pail it would remain unchanged for all time. Bacteria are numerous in the air, and under ordinary conditions it is absolutely impossible to have milk without any bacteria at all. We cannot expect to prevent the entrance of all bacterial life into milk, but the number may be greatly diminished by certain precautions. They are intimately associated with dirt and carelessness, and by the exercise of scrupulous care and the observance of cleanliness we may keep the number of bacteria down to the lowest possible limits. Then it is a fact that bacteria cannot increase rapidly in a temperature of less than 55°; when the temperature gets down to this their increase is practically suspended. Hence,

if the number of bacteria is reduced to a minimum to begin with, and then if the milk is promptly cooled with ice or spring water to 55° or below, the keeping qualities of the milk will be greatly increased, and there will be no trouble from sour milk in the ordinary course of getting it to consumers. One authority says that by these precautions milk may be kept merchantable a week or ten days. This is of the utmost importance to farmers, particularly those who ship milk to cities.

The whole "secret" of avoiding sour milk trouble is in three words, — cleanliness, prompt cooling. With these milk will withstand even the traditional influences of the thunder shower.

The first source of the infection of milk with the bacteria of souring seems an exception to the above general statement. These bacteria get into the milk pail in the first few drops drawn from the udder. At the close of the previous milking a little milk is always left at the end of the teat, a drop often remaining in the little orifice near the end of the teat. Here the bacteria multiply to an enormous extent, the warmth of the animal body furnishing excellent conditions for their increase. When the next milking is commenced they are washed into the pail to contaminate the whole of the milking and shorten its life. A material increase of the keeping properties of milk will follow from milking on the floor the first streams from each teat, enough to rinse them out.

The next and most common source of infection is through the air which is always loaded with bacteria. The number of bacteria in the air varies very largely, but the germs are more numerous in inclosed spaces like rooms than in the open air. Hence, when cows are milked in the barn the milk will have more bacteria than when they are milked in the open field. We cannot tell all of the ways in which these bacteria get into the air, but we do know that they come from particles of manure, skin, food, hair, threads and cobwebs. They are intimately associated with the dust floating in the air. From the body of the animal, the hands of the milker or his clothes may also come the troublesome little "bugs." Hence the more filthy the conditions the more bacteria and the sooner

the milk sours. Professor Sedgwick says "short-lived milk is usually filthy milk." Another authority says: "Sour milk is due to dirty handling." Grotenfelt says: "The impure air in the stable is one of the main causes of bacterial infection of milk."

STABLES.

The barn should be cleaned at least annually, removing dust and cobwebs from timbers and corners, and cleaning out all refuse and rubbish. It should then be thoroughly whitewashed. This not only removes many microbes and introduces a weak antiseptic, but it renders the stable lighter and more cheerful. Any work in the barn which stirs up a dust just before milking will greatly add to the number of the bacteria in the air and therefore in the milk. Chores which contaminate the air should be deferred till after milking. Frequent sweeping of the barn is a good idea, but it had better be omitted if it can be done at no other time than immediately before milking. Manure ought to be removed from the stable promptly, as the longer it remains in the warm stable the more the bacteria in it multiply, but wait until after milking before you do this work. Many barns are made so that it is impossible to avoid pitching hay from the mows or high beams in the room where the cattle are kept. This is favorable to stirring up a dust and therefore it ought not to be done just before milking. Feeding coarse fodder directly before milking, stirring up masses of dust, is not to be commended. Sprinkling stable floors before milking will materially lessen the germs in the milk. The free admission of outside air into the barn is also an important consideration. By care it is possible to decrease considerably the infection of milk through the ordinary dust of the stable.

The Cows.

When the cow's flanks are covered with filth, either manure or the mud of some pasture pool, the amount of bacteria that will fall into the milk is enormous. Consequently the skin of the cows should be kept as clean as possible. The importance of carefully carding, brushing and cleaning the cows is evident. To get the best results the udder and the

teats, together with the adjoining parts of the body and thighs, should be wiped with a damp cloth immediately before milking. These precautions will reduce to the lowest terms the bacteria which will get into the milk pail from the cow.

The Milker.

The milker himself must practise personal tidiness, and the leading authorities, where the best results are to be obtained, both preach and practise the importance of strict cleanliness and even the wearing of neat clothes while milking. The milker's hands should be carefully washed.

Removing from Stable and Straining.

As we have said above, no matter how carefully the precautions against micro-organisms are observed there will be bacteria in the air. The milk is therefore threatened so long as it is in the stable, and it is also liable to absorb odors as well as bacteria. Milk should therefore be removed from the stable at the earliest possible moment. Straining the milk in the stable or leaving it there in the cans until the whole herd has been milked are procedures harmful to its quality. A minute's delay in the barn may mean an hour's quicker souring. Milk always ought to be strained in a room separate from the stable, where the air is pure and fresh, and where cleanliness is most carefully observed.

Several thicknesses of strainer cloth through which the milk is allowed to trickle slowly will filter out many bacteria as well as much filth. It is therefore important, in a herd of any considerable size, to change the strainer cloth often, as it soon becomes impregnated with bacteria which have been entangled in its meshes, and some of these are liable to wash through into the milk if the same cloth is continually used. The more unclean the milk the more frequently the change of strainer cloths should take place. The more violently the milk is poured into the strainer the greater the chance of the force of the stream driving some bacteria, which had become entangled in the strainer, through into the strained milk.

A third cause of infection is unclean utensils and cans. If these are not washed with the greatest care and thoroughly

scalded and aired there is an opportunity for impurities to be left in the seams of the tin where joints occur. In this residue there is a fine opportunity for bacteria to increase and multiply in large quantities, and then spread the contamination through the milk itself. The word cleanliness, when carried to its extreme import, nowadays, means sterilization, — freedom from bacteria. Wooden pails should never be used for milking, as it is almost impossible to keep them clean. Tin utensils should be used. In cleaning them the milk remaining should be rinsed out with lukewarm water. Then boiling hot water or steam should be applied, as these are among the strongest foes to bacteria. Live steam is best but not always practicable. After scalding, exposure to bright sunlight is advisable and ought to be given. It is common to see inverted cans standing by farmers' doors, sunning the outside of the cans. If the location is one where the air is pure the cans should be set so that the direct rays of the hot sun may get into them.

Finally, having done all that is possible in way of care and cleanliness, you have not kept all the bacteria out of the milk. The ravages of the few remaining ones must be reduced as much as possible. This is done by chilling the milk at the earliest possible moment. Bacteria increase most rapidly in warm milk. One experimenter found that at 93° the bacteria in milk multipled 3,600 times in six hours. At 55° they multiplied only 435 times. Don't let the milk stand a moment longer than is necessary without chilling it. Delay is dangerous and may be costly. This cooling of milk is beneficial in removing the last traces of animal odor, but it is urged more particularly for checking the growth of bacteria. If the temperature is lowered sufficiently, the development of bacteria will be checked — almost stopped. By lowering the temperature to 45° satisfactory results may be obtained, but it is safest to cool it to 40° if possible. Every person supplying a city market with milk should have ice, or else cool spring water, and take precautions in this respect. All authorities impress the importance of straining the milk outside the stable and cooling it as quickly as possible. Don't let it stand until the cows are turned out; they can wait better than the milk.

In conclusion, — milk, leaving the udder almost in a spray, comes in contact with a large quantity of bacteria-laden air. This milk is of a temperature most congenial to bacterial growth, hence the first half hour of its life is the critical one. The way it is treated during that time determines its keeping qualities, and to a considerable extent its flavor. No wonder the best teachers say that sour milk is due to careless handling. As a matter of theory milk cared for as we have recommended will keep a long time, amply sufficient to have it reach any consumer in good condition, and the following of these suggestions will add many hours to its life. As a matter of practice many farmers take these precautions and are never troubled with sour milk. A German experimenter had a cow kept in a badly ventilated barn and milked without having its udder cleaned, and the milk, kept at 60°, coagulated in fifty hours. The milk from the same cow drawn in an open field, after the hands of the milker and the cow's udder had been cleansed, kept, at the same temperature, eighty-eight hours. Hence we have both theory and practice to back up these ideas. What one farmer has done another can do. With proper precautions there would be no renewal of the great trouble which annually exists in Boston and elsewhere during the "heated term" on account of sour milk.

Systematic Feeding and Watering as a Preventative of Disease in Horses.

BY PROF. JAS. B. PAIGE, VETERINARIAN TO THE BOARD.

I propose in this short paper to discuss very briefly a few of the more important points suggested by the above title. My idea is to show how many diseases of horses are referable to a faulty system of feeding or watering, or both combined, and how they may be prevented by the application of the principles that should guide us in this matter.

The subject is by no means a new one, numerous articles relative to it having already appeared in our books and agricultural papers; but it would seem, from the great number of erroneous ideas which people entertain and put into practice in this connection, that the information imparted has not been productive of much good. No one appreciates this more than the practising veterinarian, who can trace, in a large majority of the cases of intestinal disease, founder, etc., which he is called to treat, the cause of the same to some fault either in quantity, quality or other condition of the food used, or to some condition of the animal when the food or water was given. From my own observations I am led to conclude that it is not so much on acount of ignorance of the principles that should guide us in the feeding of horses, so as to prevent the occurrence of disease, as it is on account of failure to put the principles into practice. Many people are thoughtless or negligent about these things. This applies more especially in rural districts. It frequently happens that a fatal attack of colic is the result of thoughtlessly giving a horse a seemingly small quantity of green grass in early spring time, when he is not accustomed to it, or of carelessly throwing a few small potatoes or specked apples into his manger when they are removed from the cellar at the close of winter. Excluding fatalities

from contagious diseases and from accidents and complications, I think it a conservative estimate that four-fifths of all deaths among horses in rural districts are traceable to mistakes either in feeding or watering; and, considering that the majority of such fatalities are preventable by the exercise of care in feeding or watering, the subject under discussion is certainly deserving of most careful consideration.

Smith, in his work on "Veterinary Hygiene," says, regarding this subject: "The connection between food and disease as cause and effect is well known. Throughout the whole category of disease-producing causes there is no simple factor which exercises so much influence. The reason of this is not difficult to seek. Men feed their animals as they feed themselves. They are either overfed with highly nutritious food, or underfed with material of bad quality; or the food given is at irregular intervals, badly prepared, or unsuited to the digestive organs of the animal. Another reason for the great importance of the subject of food in relation to disease of the lower animals is that it is one of the three tangible causes we can handle."

The following is a partial list of the diseases of horses which may arise wholly or in part in connection with an irrational system of alimentation: abortion, heaves, swelled legs, lymphangitis, laminitis, scratches, stomatitis, ptyalism, glossitis, urticaria, choking, impaction of the stomach, gastric tympanitis, gastritis, stomach rupture, spasmodic and flatulent colic, intestinal impaction, enteritis, constipation, diarrhœa, dysentery, alimentary calculi, hepatitis and *immobilité*. Of diseases of the urinary system may be mentioned nephritis, hæmaglobinuria, hæmaturia and diabetes.

The subject may be viewed from two different standpoints, — the scientific and the practical.

Scientific investigation in physiology and chemistry have during recent years brought out many important points relating to the most economical and satisfactory methods of feeding our farm animals for specific purposes. Among other things, they have taught us that the animal body is composed of organic and inorganic substances, the former consisting of nitrogenous and non-nitrogenous constituents, the first particularly abundant in the muscles and similar

tissues, while non-nitrogenous substances exist largely as fats. Of the inorganic constituents we have the various salts which, taken collectively, form the ash. The salts consist of lime, potash, soda, magnesia, etc.

A chemical analysis of plants shows that we have in them compounds whose composition corresponds very closely to similiar substances found in the animal body. We find that there are in plants both organic and inorganic compounds; protein, fats and carbohydrates belong to the former, the various salts to the latter.

Through our study of animal physiology and chemistry we have learned of the action of the various digestive ferments of the body upon the plant constitutents, and now know that the digestive proteins, fats and carbohydrates of plant origin are used in the animal body for the production of muscle, bone, milk, heat, energy, etc.

In consideration of what has been learned by experimental research in physiology and allied sciences regarding the composition of animal and plant tissue and their products, the processes of digestion, assimilation, etc., one might surmise that it would be possible to compound a concentrated food ration which should supply all the various elements in the proper proportion necessary for the complete nourishment of the different tissues of the animal body. Such, however, is not the case. In order to keep the animal organism in a normal, healthful condition, we need to supply more than what is shown to exist by chemical analysis in the various tissues. A certain mechanical condition of the food is requisite, as well as a sufficiency of bulk. The digestibility of the food, the quality, etc., have to be taken into account, and we must not forget that anatomical variations have their influence in connection with proper feeding. In other words, to obtain certain results in the feeding of farm animals, we must bring into play the sum total of our knowledge of the chemistry and physiology of feeding, together with those practical points learned by experience. This applies in the case of all farm animals, it makes no difference whether we feed for growth, milk, beef, pork, mutton, or, as in the horse, for force and energy. In any case we have to bear in mind that in order to secure the best results in any particu-

lar direction we must so treat our animals that perfect health shall be maintained. This is where knowledge obtained by practical experience applies, and in this part of the subject we are particularly interested. The study of the scientific investigations of questions relating to feeds and feeding is interesting and profitable. The reader is referred to various books and agricultural experiment station bulletins for information concerning it. Unfortunately, there is a scarcity of literature upon the subject of the hygiene of feeding. What information we possess has been gained largely through the channels of practical experience, and frequently we have paid dearly for it.

One of the most important factors to be taken into account in the feeding and watering of horses is the anatomical arrangement of the digestive organs. The relative size of the stomach of the horse, as compared with that of the other domestic animals, is small. When distended, it has a capacity of twenty-five or thirty pints. In case normal digestion is taking place, it rarely contains more than seventeen or eighteen pints. The arrangement of the mucous membrane is peculiar, in that it is sharply divided into two parts, the cuticular portion being continuous with the mucous lining of the œsophagus. The villous membrane lines the right half of the stomach, extending to the pyloric opening; the left portion is preparatory in its function. The membrane of the right half contains the glands which secrete the digestive juices; the right half is the digestive portion. Stomach digestion in the horse goes on very rapidly. The length of time required to digest a food varies with its chemical composition, mechanical condition, bulk, etc. As a rule, it may be stated that the more nitrogenous a food the longer it remains in the stomach. It may happen that the nitrogenous food may remain in the stomach but a short time, being forced into the intestines by the ingestion of large quantities of non-nitrogenous material; for example, corn, oats or other nitrogenous grains ordinarily remain in the stomach longer than hay, but by feeding grains first and hay in large quantities afterwards the grains may be forced into the intestines undigested.

Colin's and Smith's experiments with reference to stomach

digestion of hay and oats are interesting and instructive. They found that when small amounts of food are given after fasting they pass directly to the right side of the stomach, becoming in a short time thoroughly mixed with and acted upon by the gastric secretions. As soon after feeding begins as the stomach attains a certain size, the ingesta passes out into the intestines as rapidly as it comes in through the œsophagus. This occurs regardless of the composition or condition of the food mass. As soon as the animal stops eating, the food passes into the intestines more slowly; it continues to pass out, however, until the stomach becomes considerably reduced in size, then the stomach empties itself very slowly. It would seem that nature intended that a portion of the ingesta should remain in the stomach to act as ballast. It requires from twelve to fifteen hours for the stomach to completely empty itself. It has been found by experiment upon horses that the ingesta arranges itself in layers in the stomach in the order in which it is taken in, that arriving first going into the pyloric portion of the organ. These layers remain quite distinct during the greater part of the time that active digestion is going on, complete mixing of the contents occurring only at the pylorus.

By the ingestion of large quantities of water soon after eating, the distinct-layer arrangement of the food is broken up and much undigested material washed into the intestines. As soon as material passes from the stomach into the intestines it comes in contact with the secretions from the liver, pancreas and intestinal glands. These secretions have both a mechanical and chemical or digestive action. The contents of the small intestines are distinctly fluid. After passing from the small into the large intestines the material is rendered more firm in consistence by absorption of fluid from it. It is also probable that considerable cellulose is digested in the larger bowels during the slow passage of the ingesta through them.

In order that we may so feed our horses as to prevent disease, aside from the anatomical arrangement of the digestive organs, we must take into account the nature of the work required, as well as individual peculiarities of different

animals. The feeding of a horse for slow farm work must necessarily differ from that of the one used wholly upon the road or track for fast work. In the former a large, well-filled abdomen does not interfere with its performing the work required of it, consequently there is little objection to giving a horse used for slow work liberal quantities of bulky food. The same food given a race horse would produce such a distension of the stomach and intestines that free and easy action of the respiratory organs would be prevented, and in consequence the horse rendered useless for fast work. Race horses require a more concentrated and easily digested food than it is necessary or economical to supply our slow-working animals.

Individual animals possessing certain constitutional peculiarities are frequently very susceptible in respect to the action of different kinds of feeds or different methods of feeding and watering. Such animals are usually nervous and excitable, are long-legged, narrow-chested, straight-ribbed and small-barrelled. They are oftentimes designated "bad thrivers," on account of the difficulty in feeding them so as to keep them in good condition. Such individuals are liable to attacks of indigestion, diarrhœa, colic, etc., upon the slightest change of feed, or irregularity in feeding or watering.

Bearing in mind some of the general principles which have been briefly referred to, we may consider in detail some of the methods of feeding and watering, commonly practised, which are most productive of disease.

First we notice the effect of an excess of food. In this we must consider the horse as a machine, which has a certain limited capacity for converting so much raw material into a finished product. We supply the horse with hay and grain, and expect in return for our outlay a definite amount of energy. Within certain limits the quantity of the product does not depend so much upon what we supply as upon the capacity of the organism to convert what is given from one form into another. A horse can take in, digest, assimilate and appropriate only a limited amount of material. If more than this definite quantity be taken, the organism must of necessity become taxed beyond its powers; *e. g.*,

if more food is eaten than can be digested and absorbed, it accumulates in the intestines, acting as foreign material, produces irritation, causing colic or a similar disorder. If, on the other hand, more food is taken, digested and absorbed than can be appropriated by the different tissues, a condition of plethora results, in which the circulatory system or the lymphatic system becomes overloaded with nitrogenous or other constituents. If overloading of the lymphatic system of the extremities occurs, we have lymphangitis, or "Monday morning disease," produced.

By many people a mistake is made in that they believe it possible, by allowing excessive quantities of rich food, to keep an overworked animal in good condition. If we investigate this subject we shall see that such is not the case. Work brings about rapid destruction of the tissue. The material to repair or replace the destroyed tissue is contained in the food of the animal. It must be brought into a suitable condition by digestion before it can be appropriated by the tissue cells. The digestive organs are capable of a definite amount of work, and an excessive destruction of tissue over what can be replaced through digested food must remain, for a time at least, unrepaired. The undigested residue of the excessive quantity of food may remain in the intestinal tract, causing disease. In case of over-worked animals, the richer, more concentrated and easily digested the food, the greater the amount appropriated by the tissues. At the same time, it should be remembered that the retention in the intestines of undigested material rich in nitrogenous constituents is attended with more danger than in case of retention of less rich food. An over-feed of grain may cause serious consequences, whereas an over-feed of hay rarely does harm. The influence of breed and individual peculiarities are so marked in relation to digestion that it is impossible to establish a rule that will apply in all cases. Our aim should always be to supply food in sufficient quantities, in an easily digestible form, so that enough nutrient material may be provided for the repair of the tissues without causing an overloading of the digestive organs. We want to preserve a condition of balance between destructive and reparative processes.

Varying the grain ration to correspond to the amount of labor performed is an essential factor in the preservation of the health of horses. An example will serve to illustrate. A horse accustomed to work a greater part of the time becomes incapacitated for further use on account of some trivial injury, or is perhaps, on account of stormy weather, allowed to stand idle for several days in the stable. Having become somewhat run down in flesh on account of continuous hard work, the owner concludes that it is a favorable time to get him in condition again, consequently he feeds the usual or larger quantities of grain to him. On visiting the stable some morning the owner is surprised to find the horse standing on three legs, the fourth, usually a hind one, being swollen to about four times its natural size. The foot of this is raised from the floor, while the leg is carried out stiffly from the body. The swollen member, high up on the inside of the thigh especially, is knotted and corded, and very sensitive and painful on pressure. The cause of the condition is usually attributed by the owner to a sprain that has occurred during the night, whereas the real source of the trouble is traceable to the large allowance of feed that has been supplied, resulting in an over-distension and inflamed condition of the lymphatics of the leg.

Hæmaglobinuria is another disease occurring under similar conditions. This disease occurs in a horse that has been driven but a short distance from the stable, after having remained idle for several days, on a full ration of grain, and is characterized by the sudden development of lameness in one or both hind legs, with cramp of the croup and thigh muscles, profuse sweating, finally inability to remain standing.

Colic, indigestion, purgation and other diseases might be added to those already spoken of, but enough have been mentioned to show the dangers attending the removal of an animal from hard work, placing him at rest in the stable on full grain ration. The rule to apply in such cases is to reduce the grain ration by lessening the total quantity fed, or substitute some lighter grain in place of a rich one, thereby lessening the quantity of proteid material in the feed. Coarse wheat bran may be used to advantage in these cases. Reduce the amount of corn or oats, and substitute an equal

quantity by measure of bran. This keeps the bowels open and active, preventing that engorgement of the system liable to occur when the heavier feeds are continued.

The effects of a deficiency of food upon the organism is not less marked than those resulting from over-feeding. This applies not alone to the total amount supplied, but also to any of the essential elements. A deficiency of proteid constituents in a food causes rapid wasting of the muscles and loss of energy. The absence of any essential salt in a food supplied growing animals leads to imperfect development of the bony system. Sodium chloride is required by all tissues of the body, particularly the blood. In order to secure normal development of the body and to maintain it in a healthful condition, it is necessary to supply in the food all of those elements required for the complete nourishment of every tissue in the body. It is therefore essential that a sufficiency in quantity and a variety of elements be supplied in the food of working and growing animals.

In many cases farmers feed their horses year after year a ration consisting of one kind of grain, the one raised upon the farm or the one bought for the lowest price in market being the one selected. I believe such a practice to be unsatisfactory, expensive and wrong in principle. Aside from the fact that a single grain with hay may not furnish the elements in sufficient quantities required for the building up of the various tissues, is it not fair to suppose that horses, like men, relish a change of diet? Experience so teaches. A horse will after a time tire of corn, and, although fed in liberal amounts, the animal does not keep in good condition of flesh and spirit. A mixture of corn, oats and bran, with perhaps the addition of a small amount of oil meal, is sure to furnish all the essential food constituents required, and is preferred by most animals to a single grain ration. Salt must be supplied in larger quantities than is found in hay and grains. The practice of keeping it continually within reach of the horse in the form of "rocks," "bricks" or "rolls" is preferable to giving it mixed with the grain.

Foods about which there are any doubts regarding quality are best omitted from the bill of fare of horses. This does not apply so much to the products of poor land as to defects

in quality due to improper curing, preservation, or the growth of vegetable or animal parasites upon the feed. To be sure, crops grown upon an impoverished soil are not as nutritious as those grown on a fertile soil. They do not nourish the animal body as well, but the effects upon the health of the animal to which they are fed are not to be feared so much as those arising from the use of such things as musty, mow-burned hay; heated, mouldy or partially decayed grains or roots. Such substances are not only deficient in nutritive constituents, but may contain material produced by decomposition or the growth of organisms which act as poisons when ingested by the animal. The rusts, mildews and smuts are included among these substances. Improperly cured hay which has become dusty exercises an injurious influence upon the respiratory organs of the horse. Musty, mouldy hay causes irritation, indigestion, colic, purgation, etc., when fed to horses. Partially fermented corn, corn meal, bran or other grains produce similar effect. Oats that have become covered with moulds, either in the field or while in storage, or other feeds in like condition, bring on in many instances, when fed, disease of the kidneys, characterized by passage of large quantities of urine. The production of abortion by feeding ergotized rye or grasses to pregnant animals is an example of disease caused by the use of feed defective in quality. Ergot may also cause gangrene of the extremities or disorders of the nervous system.

What has been said regarding the use of foods of inferior quality applies in general to all of our farm animals, but more especially to the horse. This animal is more liable to suffer on this account, owing to the structure and sensitiveness of its digestive organs.

Frequency of feeding is indicated by the anatomical arrangement of the digestive organs of the horse. On average pasturing they feed almost continuously, whereas cattle feed for a few hours during the early part of the day, remaining quiet and remasticating the food during the middle of the day, and feeding again in the afternoon. Gastric digestion goes on rapidly in equines, and as soon as the stomach becomes partially emptied the blood supply is greatly diminished. If a large amount of food is taken into the stomach

after a prolonged fast, it is not digested. The organ suddenly becomes distended, the walls paralyzed and inactive. Blood does not enter the vessels surrounding the glands, consequently no juices are secreted and no digestion takes place. Under these conditions after a short time fermentation of the food mass becomes established, gas is given off, resulting in an attack of gastric flatulence, flatulent colic, or perhaps rupture of the stomach follows. Experience has demonstrated that the same quantity of feed, divided into three parts, given at morning, noon and night, gives better results with horses than when given at two feeds.

Sudden changes of feed should be avoided. A man can make no greater mistake in the treatment of his horse than to take him from a pasture, where he has been without grain, and, in anticipation of a hard day's work or a long drive, feed him a liberal quantity of oats, corn or other grains. The folly of such treatment is apparent to any one accustomed to the care of stock. One often sees, however, just such mistakes made. The general rule, that all sudden changes in quantity or kind of food should be avoided, should be kept in mind. It applies to hay as well as grain. The change from oats to corn is especially liable to bring on colic. The change from corn to oats is not as dangerous, but may cause trouble. The addition to a grain ration of a considerable quantity of oil or gluten meal, rye, barley, wheat or pease may be followed by disordered digestion. So susceptible is the horse to sudden changes of feed that even a feed of clear bran may give rise to flatulent colic or other similar intestinal disease. An abrupt change from hay to grass, or from well-cured old hay to new, or from coarse, late-cut to fine early-cut hay, may cause disease. Substituting hayed oats or ripe oat straw for hay is no less a cause of intestinal disturbances. Wilted grass is even more dangerous in this respect than that perfectly fresh. Ensilage, roots, apples, etc., should only be given in small quantities at first. Gradually increasing quantities may be given until the digestive system becomes accustomed to the change. Uncooked potatoes in quantities not exceeding one or two quarts fed to horses are very apt to cause colic.

The practice of changing the grain during the day should

be abandoned. It is better to feed the same kind morning, noon and night. In case it is not possible to feed the same single grain or mixtures throughout the day, a feed of hay alone, or clear oats, or a mixture of oats and bran, is less objectionable than a feed of corn, provender or other rich mixture. The practice of always giving some hay with the grain is a good one. There are but few horses that will eat too much hay if fed a sufficient amount of grain to supply the greater part of the nutrient material required by the various tissues of the body. Every horse must be given some coarse material in the form of hay, straw or stalks. There must be enough to give bulk to the food mass, or the stomach and intestines soon become diseased. The writer recently learned of the death of a valuable horse by inflammation of the bowels, brought on by feeding for several days clear oats without sufficient hay or straw. Without doubt it is best to give the greater part of the hay at night, but some should be given mornings and noons, as well. Only hay should be allowed horses that are warm and sweating freely. The grain should be withheld until the circulation becomes equalized.

The preparation of food for horses is a subject upon which there exists a diversity of opinions. There are those who advocate the use of whole grain; others who prefer it crushed, while others again say it should be finely ground before being fed. Dry feed is preferred by some, wet by others. Some claim that cut hay is better than whole, while others consider a mixture of cut hay and grain (cut feed) preferable to hay and grain fed separately. The settlement of these questions must necessarily depend upon a variety of circumstances, such as kind of food, peculiarities of the individual, time allowed for eating, effects of cooking, etc. To cut hay or grind grain for a horse with sound teeth and strong digestive organs, and who has plenty of time for eating, is to incur an unnecessary expense that is of little or no benefit to the animal. The thorough mastication of food is natural for horses, and essential for perfect insalivation and digestion. The average daily secretion of saliva in the horse, according to Colin, is eighty-four pounds. The gland is stimulated to secrete by the act of mastication, especially so if the food is dry. If the hay is finely cut or the grain ground so that it

may be swallowed after little mastication, we do not get the action of the saliva on the food or the digestive organs that nature intended. That the presence of saliva is essential to perfect gastric digestion is proved by the fact that flatulence develops soon after eating, if the salivary glands are destroyed, so that no saliva passes into the stomach with the food.

We also notice the influence of imperfect mastication on the production of indigestion and colic in horses that "bolt" their feed. Where the teeth have become badly worn, in old horses, or where there is disease of them or other organs that prevents thorough mastication, it is advantageous to cut the hay and crush or grind the grain. If not done, much of the food passes into the stomach and through the intestines whole. It is not digested, therefore does the animal no good. It is practically wasted. More than this, in passing through the intestines in large quantities it gives rise to considerable irritation, and is liable to undergo fermentation. On this account, attacks of flatulent and spasmodic colic are common among horses with irregular or diseased teeth. If a horse acquires the habit of "bolting" the grain when ground, it may be prevented by spreading it in a thin layer over the bottom of the manger, or by mixing it in the manger with six or eight smooth stones the size of the fist.

Contrary to popular opinion, cooked grains, particularly oats, are more difficult to digest than uncooked ones. By cooking I refer to boiling. Smith says: "Ellenberger and Hofmeister are of the opinion that starch conversion in the stomach of the horse occurs not only through the saliva swallowed, but by the development of a ferment from the food. They found that oats could yield a starch-converting ferment active at body temperature, but destroyed by boiling. They have further stated that starch-converting ferments may in the horse be derived from the air swallowed with the food." Practical experience in feeding in large stables shows unquestionably that more horses suffer from indigestion, colic, etc., when fed cooked grain rather than uncooked. Certain foods, such as potatoes, pumpkins, etc., are rendered more digestible and less harmful by cooking.

It is quite probable that bacteria of different species taken in with the food exert an influence over the process of digestion.

The feeding of oval, spherical, square or angular pieces of roots should be avoided. Their shape favors their arrest in the œsophagus. They should be prepared for feeding by being cut into long, thin slices, or shredded by a machine. Fine, dry, chaff-like material may also cause choking. If moistened before being fed, or the animal compelled to eat it slowly, its arrest in the gullet is prevented.

The rule with reference to watering horses is based on the results of careful investigation. It is exceedingly simple and easy to remember. Either water one-half hour before feeding or one hour after. If a large quantity of cold water is given just before eating, it predisposes to attacks of indigestion. The effect of the cold water in contact with the mucous membrane is to cause contraction of the blood vessels. This forces the blood away from the stomach and intestines. If, now, food is taken in, it cannot be digested, owing to absence of blood about the secreting glands. When cold water is taken a half hour before feeding, the circulation of blood in the stomach and intestines becomes established, so that upon the arrival of the food the glands are in condition to perform their function. When a horse is fed, and watered directly afterward, the passage of the water through the stomach carries undigested food into the intestines, beyond the reach of the stomach and intestinal juices. The irritation of the undigested food in the intestines may cause colic. When heated, small quantities of water may be allowed, but giving large amounts should be avoided. Small amounts at frequent intervals may be allowed animals when on the road, and this is a general rule that may be applied in nearly all conditions of the animal.

Massachusetts Weeds.

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Emerson defines a weed as a plant whose virtues have not been discovered. The general conception of weeds is that they are useless plants, and this conception would include all of our road-side growths, such as goldenrods, etc. To the farmer, however, a weed is not only useless but a troublesome plant. Apropos of Emerson's conception of a weed, it may be stated that there are apparently useless plants whose virtues have been discovered, or, in other words, some use has been made of them. The barn-yard grass, which is a weed throughout Europe and America, has been cultivated in Japan and is now a very important forage plant.

We can divide all of our plants into three groups, — the indigenous, or native species, the naturalized, or those which have become established; and the adventive, or those which have made their appearance once or twice but which have not become established. The latter two groups, the naturalized and the adventive, include, of course, the introduced species which grow spontaneously. It must be understood, however, that they do not include *all* cultivated species. The naturalized species make themselves at home in our soil, and they grow year after year with more or less regularity in their appearance.

The adventive plants are only recent arrivals, and may be considered as candidates for admission. Some of them make their appearance sparingly year after year, without making much headway, while others simply live one year and perhaps are not seen again, or only occasionally from time to time. The conditions which largely control the appearance of the new plants are dependent upon the commercial rela-

tions with foreign countries and the new climatic conditions surrounding them.

Many of our naturalized and adventive plants have been introduced through importation, and some of them date back to a very early period in our history.

John Josselyn, an English gentleman who visited this country previous to 1672, gives a list of over thirty species of introduced plants which included such well-known forms as the dandelion, shepherd's-purse, pigweed, couch-grass, burdock, sow-thistle, stinging nettle, plantain, wormwood, chickweed, may-weed and purslane, which were grown in Massachusetts at that time, and Dr. Cutler of Salem left much valuable data concerning our introduced plants in his botanical notes, prepared previous to this century.

The writings of these early observers are of great value to botanists of the present day as some idea can be obtained as to the adaptability of the European plants. From this list of Josselyn's it will be noticed that all of these plants are common enough to-day; especially is this true in regard to dandelion, shepherd's-purse, chickweed and purslane, the latter plant being formerly grown in the garden and used for greens.

These plants found in our gardens their proper habitat, and as the cultivated areas were extended they multiplied very rapidly, until to-day they constitute the most extensive weed-growth we have to contend with. The other plants named by Josselyn, although constituting something of a nuisance, are not so abundant because the proper conditions for their thriving were not obtained.

But in order to take into consideration all of our weeds we must pay some attention to those which have been more recently introduced. The total number of naturalized plants from other countries which have been established in Massachusetts, and do now propagate themselves spontaneously, is probably about two hundred and fifty; and the total number of adventive species, or those which have grown one or more seasons but have not become established in our climate, is not far from three hundred.

While these adventive plants occur now and then on rubbish heaps, especially near manufacturing establishments

and along railroads, we cannot say when any of them may take a start and in the course of a few years become as abundant and as much of a nuisance as the white daisy or wild carrot. Indeed, we know so little about the habits of these plants that we cannot tell what they are capable of doing in our climate. We already know that among some of the earlier introduced plants some spread only slightly; for example, coltsfoot was found in Massachusetts as early as 1672 and has had many years to become accustomed to the climate, and yet it is to-day, although widely distributed, a very rare plant in our State. On the other hand purslane and shepherd's-purse are probably more abundant than at any time since their introduction. There are certain other plants, such, for example, as the *Geranium molle*, a species of comparatively recent introduction, which I have observed thriving quite abundantly for a few years on lawns, when all of a sudden it would disappear. In fact, we have observed this same tendency among many recently introduced plants.

So far as our observations go it appears to be the species which show a slow and sturdy growth that threaten to become our worst weeds. An instance of this may be seen in the white daisy. This is said to have been introduced in Rhode Island about eighty years ago for the purpose of horse feed, and another report stated that it was in Massachusetts in 1783, or one hundred and fourteen years ago. To-day on account of its gradual increase it is one of the most conspicuous plants in our neglected grass lands.

The yellow daisy (*Rudbeckia hirta*), which has never become so abundant and from present appearances would seem likely not to be, was introduced forty or fifty years ago. Ribwort (*Plantago lanceolata*), was not found by Professor Hitchcock in 1829, yet at the present time it is common enough. The fall dandelion (*Leontodon autumnalis*), quite common now, was only seen once by Professor Tuckerman of Amherst previous to 1875; and the same held true for such plants as lucern (*Medicago sativa*), sweet alyssum (*Alyssum calycinum*) and bladder campion (*Silene inflata*). In fact, there are many plants growing in Hampshire County which are not mentioned in Tuckerman's catalogue, which was carefully prepared and represented a remarkably full

list of all naturalized and adventive species. Some of these have also, in other sections of the State, become decidedly common.

Methods by which Weeds are Disseminated.

There are many methods by which weeds are disseminated. Besides the natural method, which includes the various methods of propagation characteristic of the plants, there are many artificial methods, dependent very largely upon human agencies. Besides being dependent upon seeds, there are many plants, including some of the weeds as well, which propagate themselves by means of root-stalks or underground stems, runners and running roots. Examples of propagation by root-stalks or rhizomes are furnished by the flag-root, blue iris and some ferns; while in the weeds we find a good example in the couch-grass. Plants which possess this habit are wonderfully tenacious and are the most difficult to eradicate. Golden hawkweed is propagated by runners similar to the strawberry, and the Canada thistle by running roots. These methods of propagation are, however, merely accessory methods.

The most universal method of plant propagation is by seed, and the many ingenious ways in which plants are able to disseminate themselves is remarkable indeed. One could hardly have ever seen a dandelion without having observed the admirable seed apparatus, the seed being constructed especially for being wafted by the wind. No less interesting as wind propagators are prickly lettuce, milkweed, Canada thistle and fire-weed.

Another method of seed propagation common to some weeds is by animals. Many plants, such as the pokeweed, have berries which are eaten by birds, and as most hard seeds are not digested by them they are dropped here and there. If conditions are favorable they will readily develop. Many seeds eaten by horses and cattle are not impaired, and in this manner many weeds find new abodes. Then again we find curious devices connected with seeds for attaching themselves to animals. There are many of these devices; one of the best-known plants among us which has acquired this habit is the burdock.

Through this acquired habit in seeds many plants are introduced into our State every year through wool importation. Fortunately, however, these plants are mostly confined to dump heaps about mills, and many of them at the present time have not gained much foothold in Massachusetts. Other sources of weeds are found in the importation of commercial seeds.

In oat and rye fields are the wild mustard (*Brassica sinapistrum*), chess or cheat (*Bromus secalinus*) and many other plants. One of the most impure seeds is that of red clover. The weed seeds most common in clover are rib-grass (*Plantago lanceolata*), sorrel (*Rumex acetosella*) and pigeon-grass (*Setaria glauca*). The seeds of white cockle, ragweed, prickly lettuce, pepper-grass, Canada thistle, ox-eye daisy and wild carrot are not infrequent, while those of the dandelion, etc., are often found.

Occasionally weeds as well as injurious insects and fungi are introduced with nursery stock.

Hay furnishes an excellent medium for the introduction of various weed seeds, and some of our numerous weeds owe their origin to the introduction of baled hay. Much of the glassware and crockery imported from Europe is packed in hay, and here we have a constant source of contamination. This hay is frequently used a number of times for packing purposes and is distributed to various parts of the country.

A few of our weeds were first introduced as ornamental plants and have escaped from cultivation. Golden hawk-weed was cultivated at the Agricultural College some fifteen years ago, and there are some lingering patches of this plant here which may be seen every year, and it is annually sent in from other sections for determination. In Vermont this plant has, according to Professor Jones, multiplied tenfold in the last decade and from all appearances it has come to stay.

Chiccory is said to have been introduced for greens by Governor Bowdoin in 1785, and although not abundant in the State it occurs in some localities quite frequently. Purslane was introduced from England for the same purpose as early as 1672. Wild carrot and live-forever were introduced as ornamental plants. Woad waxen was brought from Eng-

land to Salem in 1628 by Governor Endicott for the purpose of dyeing, and now it covers hundreds of acres in that vicinity.

Distribution of Weeds in Massachusetts.

The condition of the soil, climate and the nature and extent of the industries in Massachusetts are sufficient to exert quite an influence on the distribution of weeds.

The percentage of sand and chlorine in the soil is greater in the eastern part of the State than in the western, and the elevation is much less marked in the eastern. Then again the population and the variety and extent of industries are considerably greater in the eastern than in the western part of Massachusetts. These differences in the conditions are sufficient cause for variations in the weed flora. There are many troublesome plants along the coast which are rarely seen in the central or western part of Massachusetts, although the Connecticut valley region furnishes conditions — with the exception of the percentage of chlorine — not dissimilar to those near the coast. In general, we can say that the varieties of weeds increase as we approach the sea-board. There are many plants, some of which have been introduced for years, that are seldom seen inland. The conditions of soil and climate appear to be uncongenial for their growth.

The woad waxen (*Genista tinctoria*), common enough near Salem, is seldom found inland, and the same holds good for the barberry and privet, which grow so abundantly near the coast and which have probably been introduced for two hundred years.

The cocklebur (*Xanthium strumarium*) and chess (*Bromus tectorum*) abound in the waste places near Boston. The cocklebur is found inland at times, but the latter plant seldom. Many other weeds might be mentioned which are more abundant in the eastern part of Massachusetts.

A List containing Some of the Commoner Weeds of Massachusetts.

Common Name.	Botanical Name.
Barn-yard grass,	*Panicum crusgalli.*
Carpet weed,	*Mollugo verticillata.*
Charlock,	*Brassica Sinapistrum.*
Chess, cheat,	*Bromus secalinus.*
Cockle,	*Lychnis Githago.*
Cocklebur,	*Xanthium Canadense.*
Couch-grass,	*Agropyron repens.*
Crab or finger grass,	*Panicum sanguinale.*
Daisy fleabane,	*Erigeron annuus.*
Dandelion,	*Taraxacum officionale.*
Green pigeon-grass,	*Setaria viridis.*
Fall dandelion,	*Leontodon autumnalis.*
Horse-weed, fleabane,	*Erigeron Canadense.*
Pigweed,	*Chenopodium album.*
Orange hawkweed,	*Hieracium aurantiacum.*
Pepper-grass,	*Lepidium Virginicum.*
Pigweed, redroot,	*Amaranthus retroflexus.*
Plantain,	*Plantago major.*
Purslane, pusley,	*Portulaca oleracea.*
Roman wormwood,	*Ambrosia artemisiaefolia.*
Ramsted, butter and eggs,	*Linaria linaria.*
Rib-grass, English plantain,	*Plantago lanceolata.*
Shepherd's-purse,	*Bursa bursa-pastoris.*
Sorrel,	*Rumex acetosella.*
Wild carrot,	*Daucus carota.*
Yellow daisy,	*Rudbeckia hirta.*
White daisy,	*Leucanthemum vulgare.*
Three finger,	*Panicum glabrum.*
Dyer's green-weed,	*Genista tinctoria.*
Money-wort,	*Lysimachia nummularia.*

Of this list of thirty plants six are troublesome on lawns; four in gardens, twelve in hay fields, and eight are unsightly plants in waste places. Of course such a classification is not wholly accurate, as some of the weeds recorded as growing in waste places are at times found in poor grass land.

Methods of Eradication.

No general methods can be employed for the extermination of weeds inasmuch as the individual characteristics of

the plant must be taken into consideration. Various kinds of cultivation have been devised to meet the requirements of weeds, and an attempt has been made to kill weeds by powerful electrical machines. Such appliances are not practical, as the enormous voltage of twenty thousand was required to kill the plants. Could a current be made to pass through the plant from the tip of the root to the tip of the stem a much smaller voltage could be used. I have killed small plants in the laboratory with an electrical force equal to forty or fifty volts when the current was applied in this manner. Even supposing such appliances could be devised on a simple and cheap scale, so as to be utilized, they would be of no value when applied to cultivated crops, inasmuch as one of the blessings of weeds is that they remind the gardener that it is time for his crops to be hoed, and any appliance which fails to stir up the soil would be an injury rather than a help.

Other methods have been tried for weed eradication with more success. The application of chemicals to freshly cut roots, or at the base of the stem, has been used in some instances with success. For this purpose experimenters have resorted to the use of coal oil, crude sulphuric acid, salt, strong brine and carbolic acid. A few drops of carbolic acid applied with an ordinary machine oil can is considered the best method that has been devised for killing weeds with chemicals. Salt has been used with some success on the Canada thistle and golden hawkweed. Experiments upon the golden hawkweed in Vermont with salt at the rate of three thousand pounds per acre have proven effectual, and at the same time have increased the yield of grass.

In the case of biennials, cutting the root below the crown usually kills them; but occasional mowings induce them to send up numerous stalks from their roots, which, if not cut, will come to maturity and produce seed. The wild carrot affords an example of a biennial, and outside of hand pulling repeated mowing is about the only practical method which can be employed. This prevents the plant from maturing its seed, and also by checking assimilation starves the plant out.

Many root-stalks are successfully killed by exposing them to the direct action of the sun in summer or of frost in winter.

Ploughing in this manner becomes effective. Certain root-stalks possess a remarkable power for propagating themselves, and when cut up even in small pieces they are capable of growing into a new plant. Any cultivation, therefore, which only breaks the root-stalks and leaves them in the ground during warm, moist weather is not practical, as this method would only multiply them.

One of the best methods for destroying the very troublesome couch-grass is to plough it up late in the fall and sow the piece down thickly with some such crop as rye.

In fact, this is one of the best methods to which farmers can resort for weeds in general proper to cultivated lands. Instead of allowing the land to remain idle, or surrendering it to weeds, as is most frequently the case among farmers after the crop has been taken off, it should be thickly seeded down to some crop such as rye or mustard; or much better, if the climate would allow it, to crimson clover, alfalfa or melilotus.

This practice of green manuring improves the soil. It not only adds organic matter to it but it conserves the elements which the soil contains. In case a leguminous crop is grown, such as clover, alfalfa or melilotus, considerable nitrogen would be added to the soil when ploughed under. Crimson clover and alfalfa have not proven hardy with us, but melilotus appears to be, and Professor Brooks has hopes that this plant can be of some service to the farmer in this climate.

With good thick growths of rye or some such plant in the soil soon after the main crops have been removed, the large amounts of shepherd's-purse, purslane and five-finger grass — which naturally thrive at this season and produce enormous quantities of seeds for the year to come — could be kept down. The worst weeds found upon our lawns are plantain, common dandelion, chickweed, money-wort, three-fingered crab-grass and fall dandelion. The only remedy for the plantain, common and fall dandelion is spudding. The plantain is less likely to occur on a well-kept lawn. The money-wort and chickweed thrive the best in the shade, although both are more or less troublesome in sunny lawns. Nitrate of soda or common salt are used by some to kill

money-wort. It is used even strong enough to kill the grass, but new grass will eventually come up at the exclusion of the money-wort. The three-fingered crab-grass is seen abundantly late in summer, and appears to be spreading. We know of nothing to recommend for this.

The introduction into our fields of such weeds as chess, charlock, etc., is due to impure seed.

Another method, therefore, of checking many weeds, and one which would appear to be a very logical one, would be to start with pure seed. We have not in this country quite waked up to the necessity of buying pure seed, or of even buying seed of a guaranteed germination.

Some of our grass weeds can be controlled by mowing them just before they go to seed. One field at the Agricultural College which was densely covered with the white daisy a few years ago has, by this method of treatment, become almost completely rid of this plant. Other field weeds are more difficult to eradicate by this method, as their time of maturing seed does not correspond with the time of mowing grass.

SEVENTH ANNUAL REPORT

OF THE

DAIRY BUREAU

OF THE

MASSACHUSETTS BOARD OF AGRICULTURE,

REQUIRED

UNDER CHAPTER 412, ACTS OF 1891.

JANUARY 15, 1898.

Dairy Bureau — 1897–98.

D. A. HORTON, Northampton, *Chairman.*
GEO. L. CLEMENCE, Southbridge.
J. L. ELLSWORTH, Worcester.

Executive Officer.

W. R. SESSIONS, *Secretary of the State Board of Agriculture.*

Assistant to the Secretary and Acting Executive Officer, appointed by the Governor.

GEO. M. WHITAKER, Boston.

REPORT OF THE DAIRY BUREAU.

The membership of the Dairy Bureau has continued through the year the same as at the time of our last report, Mr. J. L. Ellsworth of Worcester having been reappointed. The active executive work has continued under the charge of George M. Whitaker, who has been reappointed for another biennial term. The statute title of this position is very misleading. The Bureau has had in its employment during the year three agents, the same ones previously reported, Messrs. J. W. Stockwell, George F. Baldwin and Charles C. Scott. Dr. Charles Harrington, the Boston milk inspector, and his staff are also agents of the Bureau, serving without compensation from the State, in order to promote harmony and efficiency of action. The chemical work has been done by Dr. B. F. Davenport.

Oleomargarine.

The work of the Bureau in enforcing the laws relative to imitation butter has been statistically as follows: —

Number of inspections,	1,986
Samples taken,	212
Cases in court,	26

Of these, in only two instances were the defendants acquitted.

Complaints were made for the following causes: —

Selling or having in possession with intent to sell an imitation of yellow butter,	16
Serving oleomargarine in hotels and restaurants without giving notice,	5
Obstructing officers,	5

The court cases are fewer than last year, but do not represent any diminution in the work. The number of arrests is

not a gauge of the efficiency of a police force. The open selling of deceptive imitation butter has been suppressed, but as the illegal traffic in this imitation product is crowded into more limited quarters, the amount of detective work necessary to secure evidence of a violated law is largely increased. We have this year convicted some persistent violators of the law, in some cases driving them out of the Commonwealth. To bring this about necessitated in some cases weeks of careful work. One case in particular was of more than ordinary interest, and illustrates the difficulties attending the work and the chances that the greed of gain will lead unscrupulous persons to take.

Complaint came to us early in the year from a town in Middlesex County that a peddler had been through the town selling what purported to be Vermont creamery butter at a low price. Samples were secured, analyses made, and the article was found to be oleomargarine, which had been sold as butter from tubs labelled creamery butter, the United States revenue stamps and brands having been removed. We had no knowledge of the name of the party, his residence or his routes, and a number of months' work was necessary in order to supply this information. We found he had several teams and men, and was doing a large business. Then it was necessary to locate him somewhere, and get legal evidence of violation of law from samples whose identity could be positively traced. Then came warrants for his arrest, and, having obtained these, it was again necessary to find where he was to be at some particular time, and to have officers there to serve the papers upon him. We had learned that he was an athletic fellow, given to boasting of his strength, and as a matter of precaution six officers were detailed to surround the house in which he lived, and arrest him. He gave two of the officers a rough-and-tumble chase, but they secured him. Taken into court, he was found guilty, and paid two hundred dollars, other cases being held against him for good behavior. It was not long, however, before he was heard of at his old tricks, and after a number of weeks' work was located and re-arrested. This time he gave two officers a long chase, and was not taken until shots had been fired. Detained in the lockup at South Framingham, he managed to

break out, when he was met by a pal, and the pair rode hastily with one change of horses to Rhode Island, not, however, until the lockup keeper had implanted a bullet in his thigh.

This illustrates some of the difficulties in securing a big statute record. Itinerant peddlers retailing about the State without any particular route, never more than a half day in a place, are hard to get evidence against, and, having secured it, and a warrant, they are hard to re-locate and arrest. An agent working on such a case cannot take many samples or inspect many places of business.

Another reason for the diminution in the number of cases in court is an increased conservatism on our part in multiplying cases, as we find much hesitancy among judges of the district courts to entertain more than one complaint based on one transaction. The first case that we had this year was where (1) a man had sold an imitation of yellow butter; (2) had sold it as butter; (3) had sold it without the proper marks on the tub; (4) had sold it labelled "creamery;" and (5) sold it without the distinctive marks and signs required on the wagon, — a violation of five laws of the State, but only one complaint was made. In nearly every case that we have had this year three or four laws have been violated.

During the past year we have changed our policy relative to the statute under which we have brought cases. Heretofore, recognizing that the sale of oleomargarine as butter and when butter was called for was an unquestioned moral offence, as well as a statutory one, we preferred to bring cases under that law (section 2, chapter 280, Acts of 1894) when possible, feeling that we might appeal more strongly to the court than in a case for selling (or having in possession with intent to sell) an imitation of yellow butter. But experience showed us that as a practical matter we were in error. In the former class of cases we had more to prove. It was not only necessary to show that there had been a sale of an imitation of yellow butter, but it was necessary to prove beyond a reasonable doubt that it was sold in response to a call for pure butter. Not infrequently the defendant would attempt to save himself a fine either by contradicting our

agents outright in denying that butter was called for, or else by claiming that he did not understand, and supposed butterine was called for. In such cases the judge frequently was not convinced beyond a reasonable doubt that the offence charged had been proved. This year we have brought no cases under that statute, although in nine instances the oleo was sold as and for butter; but the complaint made charged that the defendant did sell, expose for sale, or have in his possession with intent to sell —

a certain quantity, to wit, one pound of a certain product commonly called oleomargarine, made partly out of an oleaginous substance not produced from unadulterated milk or cream from the same, and that said product was then and there in imitation of yellow butter produced from pure unadulterated milk or cream of the same.

The evidence in this case is more easily secured, and less easily contradicted. As a result, we have not lost one of these cases. Of the two cases lost, one was for obstructing an officer, in which case our evidence was weak. The other was where oleomargarine had been served for butter in a café connected with a hotel. On the trial of the case the proprietor of the hotel swore that he had leased the café, and was not responsible for its management. Although having no connection with this case, we were much interested in learning, a few weeks after, that the landlord's license to sell intoxicating liquors had been taken from him for violating the provisions of the liquor law.

The great source of our trouble continues to be the State of Rhode Island, which is behind the other New England States in pure-food legislation. The whole system of peddlers and of selling on orders has its headquarters in Rhode Island. In one case the court decided that selling on orders is an evasion of the law, and the party was convicted. The defence in this case introduced the following: —

DEAR SIR: — You are hereby requested to act as my agent in getting and delivering to me the following merchandise: —

Number
Date
Signature
Number of tub Vermont.

The defence, having submitted this form of order, argued that the purchaser on signing this really made the defendant his agent; and that the defendant, as agent for the consumer, purchased these goods in Rhode Island. The judge held that the circumstances in the case convinced him that the order was a subterfuge, and an attempt to evade the law; consequently he held the defendant, who appealed, but withdrew his appeal and pleaded guilty in the superior court.

Doubtless in some instances oleomargarine is honestly desired. Unquestionably there are persons who from various motives prefer to use a mixture of lard and tallow in place of butter; but when it is sold in imitation of yellow butter, with a misleading name, or by companies with deceptive titles, there is a suspicion that consumers hardly realize what they are buying, and are more or less imposed upon by the deceptive nature of the brand or of the company doing business. In one instance we found that a peddler had been selling the goods marked "Oakdale Standard" as butter to ignorant families who did not know that this expression was the trade-mark of one of the large oleomargarine dealers. It is possibly true that now and then a person who honestly wants to purchase oleomargarine for legitimate use has been troubled to get it; but where any annoyance has been occasioned in the honest sale of a pound, we believe that the dishonest sale of ten pounds has been prevented. It should be remembered that it is perfectly legal to sell oleomargarine in this State, in a separate and distinct form, and in such a manner as will advise the consumer of its real character. But oleomargarine in that shape is a drug on the market. Its value as a commercial product comes not from the food value which the scientific men may find in it, but from the perfection of the imitation of butter. There is a theoretical oleomargarine of the chemists' laboratory, which has a food value; there is the oleomargarine of commerce, which as an imitation of butter is a constant temptation to swindling, and the temptation is seldom resisted. The supreme court of the United States says of the Massachusetts anti-color law: —

> The suggestion that oleomargarine is artificially colored so as to render it more valuable and attractive can only mean that purchasers are deluded by such coloration into believing that they are

getting genuine butter. . . . The statute seeks to suppress false pretences, and to promote fair dealing in the sale of an article of food. . . . Does the freedom of commerce among the States demand a recognition of the right to practise a deception upon the public in the sale of any articles, even those that may have become the subjects of trade in different parts of the country? . . . If an article compounded of cheaper ingredients can be made so closely to resemble butter that ordinary persons cannot distinguish it from genuine butter, the liability to deception is such that the protection of the public requires those dealing in the article in some way to designate its real character. . . . It is within the power of a State to exclude from its markets any compound manufactured in another State which has been artificially colored or adulterated so as to cause it to look like an article of food in general use, and the sale of which may, by reason of such coloration or adulteration, cheat the general public into purchasing that which they may not intend to buy. The constitution of the United States does not secure to any one the privilege of defrauding the public. The deception against which the statute of Massachusetts is aimed is an offence against society.

The following is a summary of the receipts, exports, stocks and consumption of butter at Boston for the past year, as compared with the year previous: —

	1897. Pounds.	1896. Pounds.
On hand January 1, ...	2,898,000	1,659,434
Receipts for the year, ...	51,107,033	50,972,255
Total supply, ...	54,005,033	52,631,689
Exports, deduct	3,286,333	3,156,741
Net supply, ...	50,718,700	49,474,948
Stock, deduct	2,620,680	2,898,080
Consumption, ...	48,098,020	46,576,868

The above statement shows that the consumption of butter supplied by the Boston market increased about three per cent last year, as compared with the year previous, and averaged about 925,000 pounds per week. If, by having

no laws regulating the sale of imitation butter, oleomargarine had been sold as butter, deceptively, to an amount equalling one per cent of the above consumption, the amount would be 480,980 pounds. We think that this assumption is a moderate one, from what we know of the history of the oleomargarine business, both before and after the passage of the laws, and the tendency to sell the mixture dishonestly. The average wholesale price of fresh-made extra creamery butter has been, during each month for the year, compared with two preceding years: —

	1897. Cents.	1896. Cents.	1895. Cents.
January,	20-22	22-26	24-26
February,	20-22	21-24	22-25
March,	19-23	22-24	20-23
April,	17½-22	16-22	19-21
May,	15½-18	15-17	17-19
June,	15-16	15-16½	18-20
July,	15½-16½	15-16½	18-19
August,	15½-19	15-17½	20-21
September,	18-22	15½-17½	20-22
October,	21-22½	16-20	21-23
November,	21-22	18-21	22-23
December,	21-23	20-23	23-28

If an amount of oleomargarine equal to one per cent of the sales of butter had been sold dishonestly, this amount at 20 cents per pound would equal $96,196 to the credit of the law and its enforcement, leaving out of the account the butter supplied from other commercial centres in the State, like Worcester and Springfield. This is considering only the commercial side of the case, and not recognizing the fraud on the consumer. This fact in itself ought to be a vindication of the law and a proof of its economy.

Many States have patterned after Massachusetts in dairy legislation. Although Massachusetts is not emphatically a dairy State, it has set the pace for the whole country in dairy laws. This is in a measure due to the fact that the first color case to reach the United States supreme court came from Massachusetts, and was handled with such consummate ability by Hon. A. E. Pillsbury as to secure a vindication of the law in a decision from which we have quoted above. Since then many other States have followed our example, and adopted laws almost word for word like those of this State. Probably there is no other matter in which there is so much uniformity in legislation. Some States, however, in enacting this law have provided additional safeguards against the improper sale of a deceitful imitation product, some of which are as follows: —

California declares that any article made in semblance of butter, and designed to be used as a substitute for butter, is an imitation of butter. The use of imitation butter in public or private hospitals, asylums, eleemosynary or penal institutions is prohibited. No common carrier shall receive imitation dairy products for the purpose of forwarding or transporting the same, unless they are properly branded and receipted for under their true name. The use of the word "butterine" is prohibited. Search warrants may be issued for imitation butter or cheese, which may be seized if kept in violation of the law.

The laws of Ohio not only give the dairy commissioner authority to enter any place where dairy products are sold, but go so far as to authorize him to examine the books in such places.

In Minnesota, express agents, railroad officials and employees of common carriers are required to render to the dairy commissioner all the assistance in their power, when so requested, in discovering the presence of any imitation of pure butter or cheese. The commissioner is authorized to seize imitation and adulterated dairy products, and after order of the court sell the same for any purpose other than to be used for food.

Connecticut has a law authorizing the dairy commissioner to inspect the books of transportation companies, in order to trace illegal sales of oleomargarine.

Wisconsin authorizes the issuing of warrants to search places where imitation butter or cheese is believed to be concealed, and provides for the confiscation of such imitation dairy products, and their destruction under the direction of the court or magistrate.

Michigan provides that "the taking of orders or the making of agreements or contracts by any person, firm or corporation, or by any agent or representative thereof, for the future delivery of any of the articles, products, goods, wares or merchandise embraced within the provisions of this act, shall be deemed a sale."

Critics of the oleomargarine laws sometimes raise the point that there is sometimes a departure from strict honesty in handling some grades of real butter. There is no logic in this. If A is guilty of deception, his fault is not lessened because B has also practised deception. It is a fact that there are some things in the butter trade which cannot be wholly approved. But it doesn't help one man out of the mud to find some one else with his coat spattered. The processes for working and renovating low-grade butter have been so perfected as to render the product a satisfactory article for quick consumption; still, as it is ordinarily sold, it is more or less tainted with deception. The product really comes from the cow's udder, but when it is sold as "fresh creamery butter" it is a fraud on the consumer and an injury to legitimate business. This product till recently has been known in the trade as "process butter," and by that name it could be honestly sold, although when it was distributed by the retail trade it frequently became "fresh creamery." Latterly the trade has adopted the name of "sterilized butter," which is not only a misnomer, but deceptive. The word "process" was open to objections, but the expression "sterilized" is even worse. We have had a number of specimens of these kinds of butters analyzed, and in each case the chemist has reported that the product was in some respects unusual, although he was obliged to class it with the pure butters.

We understand that the process of melting and aerating butter and re-working it in fresh milk was begun some seven or eight years ago. From that starting point the business has

extended so that there are large factories in some six or eight different places in the west. We have seen it stated that the total output of these places is fully four hundred tubs a day. The exact method of making these goods is not known. In some cases different firms have varying methods peculiar to themselves, but in a general way the process is something like this: the butter is bought either from farmers or from dealers, melted into oil, carefully strained, then aerated by pumping currents of air through it, and finally chilled by dropping onto ice or a cold surface. The granules are then churned with milk, and the product is salted, worked and packed. Fair flavor and character are the rule, but, having been once melted, the butter is peculiarly sensitive, and quickly loses its freshness; some lots become tallowy. We have a suspicion that some dishonest manufacturers may mix in more or less tallow and lard in the process of manufacturing this "sterilized" butter. We found one sample in the hands of a reputable retail grocer which was unquestionably oleomargarine. We were able to trace the shipment with such directness through a leading Boston wholesaler to a large Chicago manufacturer that we felt no end of justice would be promoted by a prosecution in this State. The facts, however, were placed in the hands of the Illinois authorities for further investigation.

Milk.

More attention has been given to milk than in any previous year. Two hundred and thirteen samples have been taken, though only one case was put into court. In this the milk was actually adulterated, but it was lost by a ruling on a law point by an associate justice of the court sitting during the vacation season. A transportation corporation had a café at one of its stations, and served adulterated milk. Samples taken tested 10.42 and 8.14 per cent of milk solids. The manager of the café was complained of, and his attorney raised the point that, under the statute holding responsible either the principal or his agent or servant, we could hold the corporation itself or the waiter who served the adulterated milk; but the attorney argued that the manager of whom we had complained was neither the servant who sold

the adulterated milk nor the principal. The justice ruled that, as the manager of the café was not personally present at the time that the waiter served the milk, he was not responsible. Another case was brought before the regular justice of the court at the conclusion of the vacation season, but by this time the defendant had left the State and could not be found.

The agricultural papers and scientific men have been discussing the idea of a statute standard of milk to an unusual extent during the past year. The principle is well established in Massachusetts, and is endorsed both by consumers and producers. Farmers' organizations have time and time again passed resolutions favoring it. Many cows produce milk of less than 13 per cent solids, but they are a minority. The Massachusetts law says milk below 13 per cent — with an exception of some summer months — is not "of standard quality," and is therefore unmerchantable as standard milk. One critic says: "What the farmer needs and has a right to ask is that the law shall not step in and try to punish him because the Creator did not make all cows alike." This is a misapprehension of the spirit of the law. Milk of standard price must be of standard quality. The opposition to the law has hitherto been largely from men whose cows produced milk poorer than the average, and who wanted to sell this poorer milk as standard milk. These persons, under the fallacious pretext that cows could not give as good milk in the summer as in winter, have succeeded in getting the very generous exception of five months in which 12 per cent is declared to be standard milk. This assertion about summer milk is not founded on fact. Mr. Clemence of the Dairy Bureau has for several years made occasional tests — usually about once a month — of the mixed milk of his herd, mostly grade Shorthorns, and he has not only found it fully up to the standard, but he has found it very uniform in quality, varying less than .4 of 1 per cent, and usually less than .2 of 1 per cent, from month to month. Many similar experiments are on record. The most recent is from the New Jersey Experiment Station. The herd there consisted of 28 cows; 23 were of mixed breeding, with 2 each of Holstein and Guernsey blood and 1 Jersey. From 18 to 26

cows were milked each month. Each month except one several fresh cows were introduced, as many as 4 each in September and March. The following is the average per cent of fat in the mixed milk (fat is the most variable element of milk, and the one that governs its quality): —

May,	4.2	November,	4.2
June,	4.3	December,	4.2
July,	4.3	January,	4.3
August,	4.4	February,	4.1
September,	4.3	March,	4.0
October,	4.4	April,	4.1

This shows the constant quality of herd milk, and that there is no marked seasonable falling off during any particular month or months.

The present attack on the statute standard comes from persons who preach that milk should be sold according to quality. With this contention we are in sympathy, and believe that milk will be sold that way in the future. There is no sense in selling 10 or 13 or 16 pounds of food all at the same price. But the advance step should not be taken at the expense of losing any of the advantages of the present law. We hardly think that the times are yet ripe for such a change, as, from the stand-point of those having some experience in enforcing the law, it would let in a large amount of adulteration.

Laws against adulteration seem as yet to need a standard. Wealthy or intelligent people could discover fraud in milk, but the ignorant would suffer imposition, and the poor might be comparatively helpless.

There is nothing in the law now to prevent milk being sold on its merits in three grades; 1st, extra; 2d, standard; 3d, skimmed.

A man with Jersey or Guernsey stock is now at liberty to make a 14 or 15 per cent milk, grade it as extra, guarantee its extra quality, and sell it at an extra price if he can find customers. On the other hand, milk low in solids can be sold at a low price by labelling it skimmed milk, — which in some instances is not far from the truth.

We hope to see many enterprising dairymen try this experiment of selling extra milk at an advance from the going

price. This ought to prove advantageous to them, and also an education to the public, being an object lesson of the differing values of milk. It would thus serve to bring nearer the time when it may be expedient to change the laws relative to the statute standard.

The following is the result of some analyses of milk taken from milkmen by officers of the State Dairy Bureau in the regular discharge of their routine duties, and throws an accurate side light on the per cent of solids sold. These samples were taken in May and June.

Worcester.

Milkman No. 1,	12.84	Milkman No. 15,	13.48
No. 2,	12.88	No. 16,	13.64
No. 3,	12.20	No. 17,	14.08
No. 4,	12.60	No. 18,	14.02
No. 5,	12.76	No. 19,	12.62
No. 6,	13.00	No. 20,	14.22
No. 7,	14.34	No. 21,	12.52
No. 8,	12.40	No. 22,	12.12
No. 9,	14.22	No. 23,	13.78
No. 10,	12.04	No. 24,	12.40
No. 11,	13.26	No. 25,	12.92
No. 12,	12.84	No. 26,	13.02
No. 13,	12.00	No. 27,	12.52
No. 14,	12.90	No. 28,	14.32

Taunton.

Milkman No. 1,	14.14	Milkman No. 4,	14.28
No. 2,	12.54	No. 5,	13.54
No. 3,	13.02		

New Bedford.

Milkman No. 1,	12.48	Milkman No. 16,	13.36
No. 2,	12.64	No. 17,	14.30
No. 3,	12.18	No. 18,	12.80
No. 4,	13.42	No. 19,	15.02
No. 5,	13.10	No. 20,	13.90
No. 6,	11.84	No. 21,	13.54
No. 7,	14.00	No. 22,	13.60
No. 8,	12.98	No. 23,	12.74
No. 9,	12.52	No. 24,	13.36
No. 10,	13.08	No. 25,	13.26
No. 11,	13.66	No. 26,	13.84
No. 12,	13.88	No. 27,	12.64
No. 13,	13.90	No. 28,	12.82
No. 14,	14.60	No. 29,	13.46
No. 15,	13.40	No. 30,	12.82

These samples were taken at summer resorts during July and August: —

No. 1,	12.72	No. 18,	11.76
No. 2,	18.04	No. 19,	12.36
No. 3,	16.96	No. 20,	12.36
No. 4,	12.56	No. 21,	11.34
No. 5,	8.14	No. 22,	10.42
No. 6,	13.74	No. 23,	14.10
No. 7,	14.06	No. 24,	12.51
No. 8,	12.22	No. 25,	11.10
No. 9,	12.46	No. 26,	10.78
No. 10,	12.84	No. 27,	10.28
No. 11,	14.16	No. 28,	12.46
No. 12,	12.40	No. 29,	11.48
No. 13,	12.84	No. 30,	16.26
No. 14,	12.48	No. 31,	12.46
No. 15,	19.02	No. 32,	12.86
No. 16,	15.46	No. 33,	12.14
No. 17,	12.54		

The samples of abnormally high milk, 19, 18, 16, per cent etc., were probably cases where there was carelessness in properly mixing the milk, and the samples which our agent happened to get were taken from the top of the can or tank. In those cases we notified the parties, recommending more care in mixing, for the person who would be served with milk from the bottom of the can or tank would have that which was correspondingly poor.

In the cases of milk which tested low we took a second sample to strengthen our position, and in every case but one the second sample was an improvement on the first, confirming still further our theory that there exists too much carelessness about properly agitating and mixing the milk. In the one exception, to which allusion is made above, the sample taken at the first visit of our agent tested 10.28, and that taken at a second visit tested 8.14.

The principal critics of the law come largely from towns which have shipped milk for many years to Boston, where there is none of the tonic that comes from producer meeting consumer, and where cows have been bred for large quantities rather than for quality.

During the past year the newspapers have reported an increased attention to the sanitary phases of the milk question.

Medical and health bodies have been discussing them, and considering possible legislation. It is a fact that legislation has hitherto looked more after the commercial fraud of selling adulterated milk, or milk not of standard quality, than it has at the health phases of the case. It is also a fact that the modern advances in bacteriology have given definite and accurate data on which we can now base intelligent and advanced action. Hence there is a good opportunity for Massachusetts to take a forward step, and for the Legislature to do something looking to enhancing the quality of the State's milk supply. But such legislation should be discreet, and should, especially at the outset, guard against steps too far in advance of the ideas of producers, or which might tend to the annoyance of petty officialism. Michigan has a system of inspection which merely leads to publishing reports of what the inspectors find. The publicity of these reports is expected to work a correction of the evils noticed. A measure as mild as this ought not to arouse great opposition, and yet it would be strong enough to have a beneficial educational influence which would tend to correct evils now existing so far as producers are concerned. A favorable report would be a good advertisement of any producer. Any filthy or unsanitary conditions at the city end of the business among wholesalers or peddlers would require different action. I submit herewith a few samples of the results of Michigan inspection, as taken from printed reports of the dairy commissioner of that State: —

At Lowell.

R. Rider. — Cows clean; stables clean; ventilation good; sanitary conditions fair; uses well water.

J. Kramer. — Cows fairly clean; stables unclean; ceilings dusty and floors dirty; ventilation good; sanitary conditions very poor; uses spring water.

At Howard City.

A. S. Stodard. — Cows poor but fairly clean; ventilation poor; sanitary conditions fair; uses well water.

William O'Donald. — Cows clean; stables unclean; ventilation good; sanitary conditions fair; uses creek water.

At Big Rapids.

C. E. Draper. — Cows clean; stables clean; ventilation fair; uses well water.

M. Boynton. — Cows clean and in good condition; stables very unclean; ventilation fair; sanitary conditions poor; well water used.

A. Card. — Cows clean; stables low and extremely dirty; drainage poor; ventilation poor; sanitary conditions very bad.

At Cadillac.

C. J. Holman. — Stables unclean; drainage imperfect and manure allowed to accumulate near stables; ventilation fair; sanitary conditions poor.

E. N. Reynolds. — Stables fairly clean; ventilation fair; sanitary conditions poor; uses lake water.

M. Berridge. — Cows clean; stables clean; ventilation good; sanitary conditions of stables good, of yard poor; well water used.

At Belding.

C. E. Lewis. — Cows fairly clean; stables fairly clean; ventilation good; sanitary conditions poor; well water used; was feeding garbage from the house.

H. C. Angel. — Cows clean; ceilings of stables dirty; drainage poor; ventilation good; sanitary conditions of yard very bad; uses spring water.

G. C. Devine. — Cows part clean and part dirty; stables clean; ventilation good; sanitary conditions of yard poor; uses well water.

At Ionia.

A. M. Welch. — Cows in very good condition; stables exceptionally clean; ventilation good; sanitary conditions excellent; uses spring water; drainage good. Cows are cleaned twice a day; wells and ceilings of stables whitewashed twice each year; has clean, well-ventilated cooling room, and all modern appliances for handling milk in a neat and systematic way.

W. D. Place. — Cows clean; stables low, with clean floors but dusty ceilings; ventilation poor; sanitary conditions poor; uses creek water.

H. Jackson. — Cows part clean and part dirty; stables unclean; drainage poor; stables exposed to open scaffolding; ventilation fair; sanitary conditions poor; uses creek water. Manure is allowed to accumulate near barn.

A. E. Jackson. — Cows part clean and part dirty; stables unclean; drainage poor; ventilation fairly good; sanitary conditions poor; uses creek water.

G. Percival. — Cows part clean and part dirty; stables unclean, ventilation good; sanitary conditions poor; uses cistern water.

L. A. Cornell. — Cows clean and in good condition; stables in poor condition; ventilation poor; sanitary conditions of yard poor.

M. S. Sprague. — Cows fairly clean; stables unclean; ventilation fair; sanitary conditions poor; uses river water.

During the past year considerable time has been given by the acting executive officer of the Bureau to work in connection with the milk business in the "Greater Boston." This is a phase of dairying which last year sent over the railroads 11,798,191 cans of milk, — an average of 32,320 cans per day. If the farmers received on an average 20 cents per can, we have here an industry amounting to $2,359,628 to the producers. The retail price in the cities varies considerably under different circumstances. Milk is being sold more and more in the grocery stores, and at a cut price. In not a few stores it is sold at less than cost, as a bid for other trade. We find retail sales made at all the way from 4 to 7 cents per quart. If we consider 6 cents an average price, the sales, which were 8,788,000 cans, amount to $4,456,000. These figures relate only to the milk that is brought into the city by railroad by the large milk wholesalers. Other statistics are not available, because the milk is brought in in different ways. It is generally believed — and the best information that we can get confirms it — that over 25, almost 30, per cent more comes in by wagons from near-by territory. Dr. Harrington has kindly given me a list, showing that 5,232 cans daily are brought into the municipality of Boston. The competition of this wagon milk and of railroad milk has been very sharp this year. If, of the amount of milk sold by the wholesalers, the amount of adulteration should equal 1 per cent of the sales, it would amount to 87,385 cans of milk. From the stand-point of the consumer, at the average price of 6 cents per quart this means $35,566 paid unjustly for water, — a $35,000 steal. From the stand-point of the producer, netting on an average 20 cents per can, it means a wrong of $17,477. This amount could be easily doubled were we to take in the whole State, with such thrifty, grow-

ing cities as Lawrence, Springfield, New Bedford, Holyoke, Taunton, Fitchburg, Gloucester and others. No one would for a moment argue but what, were it not for the existing laws and the way they are enforced, the percentage of adulteration would be much more than 1 per cent.

The figures below give the amounts of receipts and sales of railroad milk — in 8½-quart cans — as reported by the wholesalers' association during the year of 1897, also the figures of previous years, for purposes of comparison: —

	Received.	Sold.	Surplus.
January,	923,852	705,324	218,528
February,	835,115	639,952	195,163
March,	960,084	719,814	240,270
April,	976,996	733,298	243,698
May,	1,105,325	759,875	345,450
June,	1,115,234	752,038	363,196
July,	1,013,552	789,849	223,703
August,	966,058	720,374	245,684
September,	956,445	732,795	223,650
October,	1,037,764	751,944	285,820
November,	962,552	708,459	254,093
December,	945,274	724,850	220,364
Total,	11,798,191	8,738,572	3,059,619

	Receipts.	Sales.	Surplus.
1896,	10,772,108	8,087,378	2,684,730
1895,	9,856,500	8,040,732	1,815,768
1894,	9,705,447	7,657,421	2,048,026
1893,	9,263,487	7,619,722	1,643,765
1892,	9,212,667	7,315,135	–

The three million cans of surplus milk have been kept off the milk market by the contractors, thereby tending to steady the price and keep it more uniform than if the whole product was placed upon the market to be sold for what it would bring, as is the case with other articles of merchandise. This surplus kept off from the market has been made into butter by the wholesalers, and they return to the farmers the average jobbing price of butter, less the charge for manufacturing. This surplus milk has averaged to net the farmers 13.33 cents per can during the year. The lowest price was received in May, June and July, 11 cents per can; the highest in December, 15.34 cents. The price received for sale milk is the same as last year. It has been kept quite uniform from year to year, by the system in which Boston milk is handled. The price of surplus milk depends upon the market value of butter, and has averaged one-third of a cent more for 1897 than it did for 1896.

For the months of April, May, June, July, August and September, the price to the farmers at their several railroad stations was 19 to 26 cents per 8½ quart cans. During the other months of the year, January, February, March, October, November and December, the price ranged from 21 to 28 cents. This range of prices is adjusted by an agreement between the producers and the wholesalers that the price shall decrease by a regular system as the distance from the city and the cost of transportation increases.

We present herewith a plan illustrating this. The vertical parallel lines represent the railroads over which milk is shipped, drawn as air lines. We have marked on each one the location of each milk-shipping station, and its relative distance from Boston as the railroads run. We have drawn across this map horizontal lines, showing the belts of the different prices. If the arrangement above alluded to between the producers and the wholesalers was lived up to literally, these horizontal lines in all cases would be complete and exactly parallel with each other. In some cases it is necessary to depart from the literal application of this rule, as where milk is taken from a branch road which crosses the main line on some other route. For instance, milk is brought to Boston from Barre by the direct line of the Cen-

tral Massachusetts, and also over the Boston & Albany road. By one way Barre is 108 miles from Boston, and by the other 64. But it would be difficult to pay different prices at the same place, and the 64-mile price must govern. These variations from the schedule are noted by dotted lines about the towns affected.

The milk laws of other States contain some interesting suggestions.

Minnesota prohibits the keeping of cows for the production of milk for market or for manufacturing the same into articles of food "in a crowded or unhealthy condition." The dairy commissioner is required to furnish all the dairies shipping milk to the city, and all the peddlers or venders of milk in the cities within the State, with blanks for the purpose of making a report of the amount of milk and dairy goods handled, "and all milk dairies, milk venders and milk peddlers shall send to the State food and dairy commissioner quarterly reports of all the business done by each and every such person, firm or company in handling dairy products during the last three months past, as designated under the different headings of printed blanks. No person shall sell or offer for sale any cream that contains less than 20 per centum of fat."

Minnesota is the only State, so far as we know, that has a law relating to clean cans. It is as follows: "Any person, persons, firm or corporation who receives any milk or cream in cans, bottles or vessels which have been transported over any railroad or boat line, where such cans, bottles or vessels are to be returned, shall cause the said cans, bottles or vessels to be emptied before the said milk or cream contained therein shall become sour, and shall cause the said cans, bottles or vessels to be immediately washed and thoroughly cleansed and aired."

Wisconsin authorizes its dairy commissioner to make regulations when needed concerning the cleanliness of utensils, rooms, buildings, etc., used in the sale of dairy products.

Chapter 425, Acts of 1894, is as follows: "No producer of milk shall be liable to prosecution on the ground that the milk produced by him is not of good standard quality, unless the milk alleged not to be of such quality was taken

upon the premises or while in the possession or under the control of the producer by an inspector of milk or by the agents of the Dairy Bureau or State Board of Health, or collector of samples duly authorized by such inspector, and a sealed sample of the same given to the producer."

This was enacted in the expectation that it would in some way save innocent farmers from any hardship growing out of the enforcement of the milk laws. It has not accomplished any such purpose, but has hindered the prosecution of those who have sold adulterated milk.

Chapter 264, Acts of 1896, section 1, says: "No person shall sell or offer for sale or exchange, in hermetically sealed cans, any condensed milk or condensed skim-milk, unless in cans which are distinctly labelled with the name of the person or company manufacturing said condensed milk or skim-milk, the brand under which it is made, and the contents of the can."

The Bureau has been asked during the year to pass upon the meaning of the word "contents," in the last line. The popular opinion prevailed that it required either the weight or the analysis of the contents. The question was referred to the Attorney-General, who held that the word refers back to the words "condensed milk or condensed skim-milk," in the second, fourth and fifth lines, and that the law would be complied with if the can should be labelled "condensed milk," or "condensed skim-milk," as the case might be. This seems to take out of the law what seems to be its spirit.

Ohio has a law which requires that the proportion of milk solids contained in condensed milk shall be in amount the equivalent of 12 per cent of solids, in crude milk, and of such solids 25 per cent shall be fat. Condensed milk cannot be sold in that State unless the same is made from unadulterated and wholesome milk from which the cream has not been removed.

In view of the great variation in the quality of condensed milk, and its increasing use, similar legislation may be needed in this State.

The sale of cream is increasing. Maine is the principal source of the cream in the markets of Boston and other

Massachusetts cities. Comparative statistics are not available at the time of making up this report, but the following compares six months of 1897 with preceding years: —

The Hampden, Me., creamery makes the following report of its business for the last three years, showing the increase in the use of cream (the figures are for gallons): —

Thick Cream, 40 Per Cent Butter Fat.

	1894.	1895.	1896.	First Six Months of 1897.
Boston and vicinity, . . .	33,466	40,141	43,542	28,034
Beverly, Lynn and Salem, .	8,033	8,811	9,482	4,333

Educational.

The statute creating the Dairy Bureau imposes some educational work upon it. So far as this can be done by the acting executive officer, it incurs no extra expense, as he is a salaried officer. He, therefore, holds himself in readiness to respond to calls of granges, farmers' clubs, milk producers and others, for talks on various phases of dairying, as desired. He has answered eighteen such calls this year. Many of these talks have been illustrated by operating the Babcock milk tester, and in other ways so as to make them interesting object lessons as far as possible. In addition, the members of the Bureau, Dr. Lindsey, Dr. Peters and a few others, have, in exceptional cases, been engaged.

A bulletin on the care of milk has been prepared for circulation among the producers of sale milk. A circular of warning to butter-makers, regarding fraudulent cream "ripeners," has also been issued.

Last August a convention of dairy and food commissioners was held in Detroit, and a permanent organization effected. The States represented in the governing board are Ohio, Michigan, Iowa, Pennsylvania and Massachusetts. The association can be of great value in furnishing a means for an interchange of ideas, experiences and practices. Though much of the time of the convention was occupied with rou-

tine business, many valuable points and suggestions were received.

Finances.

The following is the manner in which the appropriation of $7,000 has been expended: —

Members of the Bureau, travelling expenses and attending meetings,	$446 00
Agents' salaries,	2,350 50
Agents' expenses,	2,473 08
Chemist,	858 00
George M. Whitaker, travelling and office expenses, supplies, mileage tickets, etc.,	729 41
Educational work,	102 71
Printing,	28 92
Supplies,	11 38
Total,	$7,000 00

GEORGE M. WHITAKER.

Accepted and adopted as the report of the Dairy Bureau.

D. A. HORTON.
GEO. L. CLEMENCE.
J. L. ELLSWORTH.

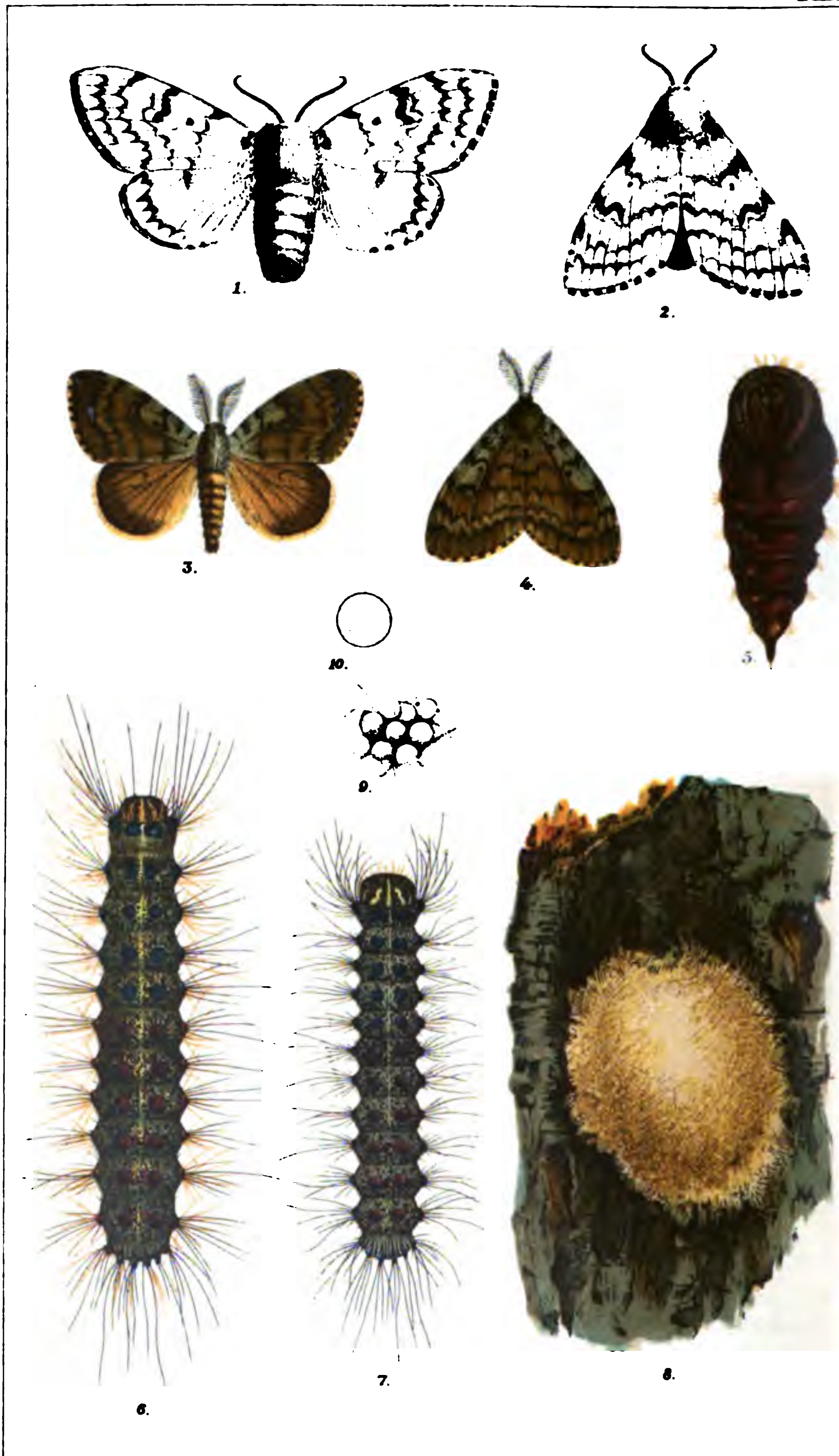
REPORT

OF THE

STATE BOARD OF AGRICULTURE

ON THE WORK OF

EXTERMINATION OF THE GYPSY MOTH.



Drawn by Joseph Bridgham. Geo. H. Walker & Co. Bost

GYPSY MOTH.

An Explanation of Plate I, with a Short Description of the Different Forms of the Gypsy Moth and its Feeding Habits.

The Eggs.

[Fig. 8, cluster of eggs on bark; Figs. 9 and 10, eggs magnified.]

The eggs are deposited in clusters, averaging about six hundred eggs each, and covered with yellow hairs from the body of the female moth. These egg-clusters are usually found in sheltered places on the bark or in the crevices and cavities of trees, stumps and undergrowth; also on fences and buildings and in the crevices of stone walls and other objects, near the plants or trees on which the insect feeds. The eggs are laid in July, August and September, and hatch after the foliage starts in the late spring or early summer of the ensuing year; therefore the insect passes the fall, winter and early spring in the egg.

The Larva or Caterpillar.

[Figs. 6 and 7.]

When first hatched the caterpillars are less than one-fifth of an inch in length. As they grow larger they may be seen in clusters upon the trunks and branches of trees or in the cavities and other hiding-places where they gather in June, July and the first part of August.

The Pupa.

[Fig. 5.]

The caterpillar when fully grown sheds its outer covering and becomes a pupa or chrysalis. This usually occurs in July or August. The pupa may be found in the same situations as the eggs. In Massachusetts the insect usually remains in the pupal state from ten to thirteen days, emerging as a moth at the end of that period.

The Moth.

[Figs. 1 and 2, female; Figs. 3 and 4, male.]

The female moth usually deposits her eggs very near the abandoned pupa case, and within a few hours after emerging from it. She dies soon after. The male is a rapid flyer. The female does not fly.

Habits of the Caterpillars.

The gypsy moth feeds only when in the larval or caterpillar state. In Massachusetts the eggs of the gypsy moth begin hatching about April 20, and the young continue to emerge until the middle of June. The length of larval life varies somewhat according to circumstances, but probably averages at least ten weeks; therefore the feeding season in this country lasts about four months. When the caterpillars are first

hatched from the eggs they are light in color and covered with whitish hairs. In a few hours they assume a dark hue. They usually remain on or near the egg-cluster until they change in color, and should the weather be cold they sometimes remain for several days in a semi-torpid condition upon the egg-cluster. If the temperature is favorable they usually search for food before they are twenty-four hours old. During the first few weeks of their existence they remain most of the time on the leaves, feeding mainly on the under side Their feeding habits are so uncertain that no rule can be given which will apply to all individuals, but before they are half-grown they generally begin to manifest their gregarious instincts. At that time and for the rest of their existence as caterpillars they spend a large part of the day clustered in sheltered situations, and feed principally at night, going up the trees and out on the branches after dark and returning before daybreak. When they are so abundant that the food supply is insufficient they evince much restlessness, and feed in numbers during all hours of the day and night. They may then be seen hastening to and fro, both up and down the trees. Those which have fed sufficiently are at once replaced by hungry new-comers, and the destruction of the foliage goes on incessantly.

At such times the trunks and lower branches of trees are covered with a moving mass of caterpillars, hurrying throngs are passing and repassing, and nearly every leaf or denuded stem bears up one or more of the feeding insects. The rustling caused by their movements and the continual dropping of excrement is plainly audible. On tall trees the larger caterpillars appear to crawl to the higher limbs, and they seem to prefer to feed well out toward the end of the branches. They do not feed gregariously except when in great numbers; therefore they seldom strip one branch only, as do the larvæ of the *Euvanessa antiopa*, but scatter throughout the trees, eating a little from each leaf. Early in the season when they are small and few in numbers, their ravages are scarcely noticed; but as they grow larger and more numerous, their inroads on the tree decrease the foliage area night by night, until suddenly all the remaining leaves are eaten, and the tree is stripped in a single night.

Food Plants.

The gypsy moth is known to destroy the foliage of nearly all native and introduced trees and plants of economic importance. The list of its food plants includes nearly all evergreen and deciduous trees, most bushes, shrubs, vines and vegetables, and it has been seen to eat grass and grain. Wherever the caterpillars become numerous they move slowly, devouring nearly every green leaf and bud as they go. They feed during a much longer season than the canker worm or the tent caterpillar. In the months of June, July and August, 1891, trees which had been stripped early in the season and whose leaves had again put out were again defoliated by these caterpillars and kept bare all summer; therefore, not only was all prospect of a fruit harvest destroyed, but many trees were killed by this continual defoliation.

Commonwealth of Massachusetts.

To the Massachusetts State Board of Agriculture.

Your committee, to which was committed the work of exterminating the gypsy moth, under the orders of the Legislature, herewith presents the report of expenditures and of work performed during the year 1897.

The balance on hand Jan. 1, 1897, as reported last year, was $8,849.85. This balance was retained to enable the committee to close up the work and turn over the material on hand belonging to the State, without the necessity of a deficiency appropriation, should the Legislature decide to make no further appropriation. But, under the advice of authorized State officers, the committee was led to conclude that the work could be continued "during the month of January, until the pleasure of the General Court should be made known, at the rate of expenditure authorized by the appropriation of the preceding year." In this way the committee was enabled to avoid the discharge of the efficient men then in its employ.

The Legislature acted promptly, and on February 26 appropriated $150,000 for the work of 1897. This prompt action, so different from past experience, was in a high degree advantageous, as it enabled the committee to do an immense amount of necessary work that could be done only before the appearance of the young caterpillars in the spring. The sum appropriated by the Legislature, however, was only three-fourths of the amount estimated by the committee as necessary for the effectual carrying on of the work required by law. With only three-fourths of the required amount available, the plans for the year were necessarily revised, and much work that had been planned had to be abandoned and must now be reported as still undone.

During the years 1895–96 most of the territory comprised in the infested towns had been quite carefully in-

spected, and, as it was believed that no large unknown colonies existed in the infested region, it was planned in 1897, first, to work thoroughly all known colonies, especially those in the Saugus woodlands. During January, February, March and the first part of April the men were employed in cutting underbrush and dead wood, and in trimming and otherwise preparing the infested localities for the work of the burlapping season. As soon as the appropriation became available the force was increased, so that on April 1 three hundred and fifty-four men were in the field. This force was largely employed during the first part of April in continuing the cleaning up of infested localities and destroying the eggs of the moth in woodland colonies, principally in Saugus and Medford. A supply of burlap was purchased, and during the latter part of April and the month of May was put on the trees in most of the known infested localities. While this was being done, the scattered eggs of the moth upon the ground in the woodland commenced hatching and the caterpillars began ascending the trees. In some of the worst colonies, where the undergrowth had been removed, the trees had been previously banded with insect lime. In these places the caterpillars were either destroyed by starvation or killed by fire before they could ascend the trees. In other cases spraying was resorted to. Arsenate of lead was the insecticide principally used, and, though its effect was somewhat neutralized by continuous wet weather, it greatly reduced the number of caterpillars. During the summer the force of men, which at one time numbered three hundred and eighty-seven, was used almost entirely in attending the burlaps. While the increase of the appropriation over that of 1896 has enabled the committee in 1897 to clear away the underbrush from the worst infested woodland colonies and to destroy a large proportion of the caterpillars in the Saugus woods, the legislative reduction of twenty-five per cent. from the committee's estimate of $200,000 for 1897 has made it impossible to extend to all quarters the scheme of work planned for the year; hence the work in the Medford woods (Middlesex Fells region) was not so complete as that done in Saugus.

The force of men was necessarily reduced in August by the discharge of one hundred and twenty-five men, and all work was suspended for two weeks in September, therefore it was impossible to inspect thoroughly all of the colonies when the burlap was taken off. The known colonies in the Saugus woods were inspected in the latter part of September and in October, and the eggs on the trees destroyed. This having been done, the men in that section were put at work inspecting the known colonies in Lynnfield, Salem, Marblehead, Swampscott and Peabody, and destroying the few eggs which could be found in these towns. The rest of the force was concentrated in the Middlesex Fells region, in Medford, where the moths had been hardly held in check by the work of the previous winter, spring and summer. Here a force of ninety men was kept at work destroying the eggs of the moth until December, when, the appropriation having been nearly exhausted, a large proportion of the men were discharged.

The result of the year's work is, that where there were three badly infested colonies of a thousand acres each in the woods of the infested region there now remains only one such colony. In that one the increase of the moths has now been checked, but they are more widely scattered there than they were in 1896; therefore the cost of treating this Middlesex Fells region will be greater another year than it would have been had sufficient means been provided in 1897 to check the increase and spread of the moth there. The known colonies in the outer towns have been attended to, and their favorable condition, as reported last year, has been maintained and in many instances improved. Only one new point of infestation outside of last year's lines has been discovered, and this place, situated in the town of Lincoln, has been promptly and carefully attended to. It was discovered in woodland at some distance from the highway. From all indications, it has been infested for several years. It would have been found long before had sufficient means been provided for a thorough inspection of all the towns near the infested region.

The reports of past years have stated that there were large woodland colonies of the moth in the central part of the in-

fested region, which, from lack of money, have necessarily been neglected, in order to attend to the outer circle of infested towns. In this outer circle the object has been to reduce the area infested and to prevent the moths spreading into new territory, beyond the known line of infestation. The committee has also reported that from the woodland colonies, in the central towns, the moths would be liable to spread into territory not previously infested and also into the area that had been cleared of the moth. The woodland in Medford, Malden, Melrose, Winchester and Stoneham has largely been taken for park purposes, and developed by the construction of boulevards and roads for driving and bicycling and paths for foot passengers; in short, it has become a place of resort for the people. Street-car lines have also been constructed on roads passing through infested woods in other towns. The result has been, as was predicted in former reports, that the caterpillars have been brought out of these woodland colonies on carriages and teams and on the clothing of persons, and thus land already cleared at much labor and expense has become reinfested. To prevent the neutralization of exterminative work in this way, great efforts have been made at large expense during the past year to suppress these larger colonies. Vast quantities of eggs were destroyed during the winter and early spring, large areas of woods and brush were thinned out or cut down, and much land was burned over. The plan proposed by the committee in the last report was to do this work and also continue the careful inspection of the outside territory, *i. e.*, that beyond the outer circle of infested towns, as well as that formerly infested but now thoroughly cleared. This plan has been followed as closely as was possible with the amount of money appropriated. But only three-quarters of the work planned could be accomplished with three-fourths of the appropriation asked for. The trees in the vicinity of all points where the moths have been found in the outer towns within the past three years have been burlapped and carefully attended. This has served to verify the work of former years and to show where that work was not absolutely completed, and has also proved that caterpillars have, as was feared, been scattered from the badly infested woodland colonies in the cen-

tral towns into territory formerly cleared. The outer towns are in good condition, and the burlap has proved our last year's statement of the situation to have been correct in nearly all cases. Had $200,000 been provided for the work of the season of 1897, all the known colonies in the infested region could have been cleaned up during the spring and thoroughly worked during the summer. This would have prevented the scattering of the moths from these badly infested colonies into territory previously cleared; the committee could have avoided the discharge of many experienced and trustworthy men, and by retaining their services the known infested localities could have been put in such excellent condition that in the work of 1898 the badly infested colonies could have been attended to at less cost.

The work of the past few years has convinced the committee that extermination of the moth is not only possible, but certain, if sufficient sums be promptly appropriated for the purpose. The committee recommends that $200,000 be appropriated for the work of 1898. While a larger sum than that could now be used to advantage, the committee believes that under the present conditions, with our experienced and trained men, a long stride could be made with that sum toward extermination. Most of the worst colonies of the moth are now so reduced that with $200,000 they all can be attended to and a reasonably thorough inspection made of all the towns in the infested territory.

Unless the work above outlined can be done during 1898, extermination will be gravely imperiled by reinfestation from the central woodland colonies. Inadequate appropriations necessitate doing the same work over and over, year after year, with comparatively little progress toward extermination; and the committee believes that, unless the necessary means can be provided, the Legislature had better make no appropriation, and so abandon the work.

The appropriation for 1897 is exhausted, and the committee hopes that the Legislature will act promptly, to save the dispersion of the force, so that the work may go on consecutively, and the loss be avoided which always comes from cessation of work.

Interest in the extermination of the gypsy moth is wide-

spread, particularly among economic entomologists and agriculturists. Scientific men in most of the countries of Europe have obtained the committee's reports and express their approval of the work. Prominent journals in Europe have published comprehensive reviews and discussions of the work, in every case speaking of it favorably. The economic entomologists of this country with one accord express themselves as anxious that the work should be continued, not only for the protection of the country from a new imported pest, but as a demonstration of what government can do for the advantage of the people; many of them having stated that they believe it would be a public calamity to have the work stopped.

At the National Farmers' Congress, held at St. Paul, Aug. 31 to Sept. 1, 1897, the matter, as in former years, was considered, and the following resolve adopted: —

Resolved, That the efforts of the Commonwealth of Massachusetts in endeavoring to exterminate the imported pest known as the gypsy moth meet with our hearty approval, and we, members of the Farmers' National Congress, assembled at St. Paul, earnestly appeal to the Congress of the United States to aid our sister State in exterminating what is liable to prove a national pest if neglected.

At the last meeting of the Association of Economic Entomologists, held in Detroit, Aug. 12 and 13, 1897, the following preamble and resolve were unanimously adopted: —

Whereas, The Association of Economic Entomologists is familiar with the efforts being made by the State of Massachusetts to exterminate the gypsy moth; and

Whereas, On two former occasions it has endorsed this undertaking by public resolutions; and

Whereas, The existence of the gypsy moth in Massachusetts is a standing menace, not only to the agricultural and forestry interests of that State but to those of the country at large; therefore, be it

Resolved, That this association would urge upon the people of Massachusetts the danger of dilatory measures, and the wisdom and great importance of providing liberally for the work of exterminating the gypsy moth.

In January, 1897, a careful inspection and investigation of the exterminative work was made, under the auspices of the Massachusetts Society for Promoting Agriculture, by Prof. John B. Smith, entomologist of the New Jersey Experiment Station. His report has been largely given to the public through the press. In it he speaks in the highest terms of the work of the committee, and expresses the opinion that extermination is possible if sufficient means are seasonably provided. He recommended that it would be well to investigate the natural enemies of the gypsy moth in Europe, with a view to introducing any insect enemy of the moth that might be of advantage. While the members of your committee consider the results of such an investigation to be problematical, they will be ready at any time to carry it out should the Legislature provide the means.

The entomologist of the United States Department of Agriculture, under the instruction of Congress, has been making an extended inspection of the work and an investigation of the methods in use. The report of his investigation will very soon appear as a bulletin of the United States Department of Agriculture.

Experiments have been continued in perfecting spraying machinery and insecticides at the insectary in Malden and the experiment station at Amherst. In addition to the regular experimental work, a large number of injurious insects, erroneously supposed to be the gypsy moth, which were sent to the office of the committee by residents of the infested region, have been identified and advice given concerning remedies.

The committee desires in this connection to emphasize its grateful appreciation of the value of the scientific work as conducted by Prof. C. H. Fernald, entomologist of the Board.

Reference is also made to the reports of Prof. C. H. Fernald, entomologist, and E. H. Forbush, director, presented herewith as a part of the report of the committee.

Financial Report for 1897.

The gypsy moth committee of the State Board of Agriculture presents below its financial report for the year 1897: —

Balance on hand Jan. 1, 1897,		$8,849 85
Appropriation Feb. 26, 1897,		150,000 00
		$158,849 85
Wm. R. Sessions, expenses,	$20 25	
E. W. Wood, expenses,	20 96	
Augustus Pratt, expenses,	61 00	
F. W. Sargent, expenses,	50 40	
J. G. Avery, expenses,	140 55	
S. S. Stetson, expenses,	46 75	
C. H. Fernald, expenses and remuneration,	561 29	
E. H. Forbush, director, salary,	2,300 00	
Travelling expenses of director and men,	1,350 47	
Teaming, livery and board of horses,	3,653 30	
Wages of employees,	134,711 54	
Rent of offices,	427 64	
Supplies, tools, insecticides, etc.,	13,206 76	
		$156,550 91
Balance on hand Jan. 1, 1898,		2,298 94
		$158,849 85

The balance indicated as on hand Jan. 1, 1898, will all or nearly all be required to pay bills for labor, material and running expenses already contracted; hence the appropriation must be regarded as practically exhausted.

E. W. WOOD,
S. S. STETSON,
JOHN G. AVERY,
AUGUSTUS PRATT,
F. W. SARGENT,
WM. R. SESSIONS,

Committee of the Board of Agriculture in Charge of the Gypsy Moth Work.

Workers killing the eggs of the gypsy moth in the Middlesex Fells Reservation. This illustrates the expensive work that must be done in badly infested localities in forest parks.

Report of the Entomologist.

To the Committee on the Gypsy Moth.

Gentlemen: — The most important question arising in connection with the work on the gypsy moth is whether it is possible to exterminate the pest. If this can be done, there is no question but that it is the wisest policy to continue the work till the extermination of this insect is accomplished. I have made frequent and careful examinations of the work from the beginning, and have seen colony after colony absolutely exterminated, some of them in localities where the difficulties in the way appeared to be insurmountable and as great as could be found anywhere, and yet the insect was completely exterminated by the force under the oversight of the field director. Not only have single colonies been exterminated, but entire towns have been cleared and for several years no gypsy moths have been found in them.

Several years ago all the leading economic entomologists of the country were invited to inspect the work of extermination and report on the same. Some of these gentlemen before visiting the territory expressed the opinion that this insect could not be exterminated; but, having made a careful study of the territory, the apparatus and the methods of work, they all became thoroughly convinced that extermination is possible, provided sufficient money be appropriated for the purpose. The reports of these gentlemen have been published in previous gypsy moth reports. Last winter the members of the Society for the Promotion of Agriculture employed Prof. J. B. Smith of Rutgers College as an expert to investigate the work and make a written report to them. Professor Smith, who is undoubtedly one of the very highest authorities on economic entomology, made a very careful study of the infested territory, the methods of work, etc., spending nearly a week in his investigations, and came to

the conclusion emphatically that extermination is not only possible but entirely practicable. The report of Professor Smith was a masterly production, and I deeply regret that the Society for the Promotion of Agriculture has not seen fit to publish it.

Since all the experts who have carefully and fully investigated the matter believe extermination to be possible, and, as previously stated, we have already exterminated numerous colonies, many of them in the most unfavorable places and of considerable extent, there can be no question but that what has been done in one place can be done in another, and that the complete extermination of this insect is possible, so that the result is dependent entirely upon the action of the Legislature.

I have no doubt that the gypsy moth would have been practically exterminated by this time if the Legislature had each year made the full appropriation asked for, and made it available early in the season.

The next important question is, how long it will take to complete the work of exterminating this pest and how much it will cost. The estimate of time and money given in my report of last year is as close an estimate as I can make at this time, since we were not able during the past year to make that progress in the work which we should have made if the last Legislature had appropriated the full amount for which the committee asked, instead of a much smaller sum. That estimate was "an appropriation of not less than $200,000 a year for a term of not less than five years, and then an appropriation of not less than $100,000 a year for a term of not less than five years. After this an appropriation of perhaps $15,000 a year for a period of five years will be required." The first five years, with the full appropriation of $200,000 a year, will reduce the territory to such an extent that with $100,000 a year for the next five years the insect will be practically exterminated, and the remaining five years will be spent in a careful watch of the entire territory, lest a few insects might have been overlooked in isolated localities. Unless a sufficient amount is appropriated to make a very substantial gain each year, it would be better to abandon the work entirely.

The metropolitan park system in Boston and some of the adjacent cities and towns is threatened by this insect, and, in fact, the Middlesex Fells reservation belonging to this system is already infested by the gypsy moth. The expense of exterminating this insect in a public park is far greater than from the same area of ordinary forest land, for the reason that in the latter case all the shrubs, underbrush and small trees can be cut down and burned, or, if need be, the land can be entirely cleared and burned over; while this course could not be adopted in a public park like the Boston Common or Public Garden, or even in Franklin Park or any portion of the metropolitan park system. If, therefore, the State should abandon the work of exterminating the gypsy moth, this insect would soon spread all over these parks, and the tax payers of Boston would be perpetually taxed for one-half of the expense of clearing the moth from the metropolitan parks, while the other cities and towns in the metropolitan district would pay the other half, and Boston would be taxed for the entire expense of the work in the Boston parks. I feel very sure that any one who has had any considerable experience in the field work on the gypsy moth would agree with me in the opinion that the annual tax on the city of Boston and the other towns of the district would then be far more than it will be if the Legislature makes the necessary appropriations for the extermination of this insect within the limits of Massachusetts. And it must especially be remembered that this question of gypsy moth extermination is by no means mainly a local one.

Should the gypsy moth escape from control,—as it assuredly would do if the work of extermination were to cease,—it would spread in all directions, doing incalculable damage over the whole State. Extermination would then be impracticable, and a perpetual warfare against the moth—most unsatisfactory in results, yet necessitating oppressive expense to all time—would then be entailed upon the people of Massachusetts. The most economic policy for the tax payers of Boston, as well as for the entire Commonwealth, is to have the insect exterminated as soon as possible.

It is an unwise and dangerous policy to make smaller

appropriations than are necessary for a vigorous prosecution of this work. The supposition that, as in many other public works, a small appropriation will carry it on to a certain point, and then, if left, it can be taken up again and carried on from where the work left off, is an incorrect one, for the reason that this insect is continually multiplying and spreading when left to itself, and there is always the danger in such times that it may be carried off accidentally along the lines of travel to remote parts of this State or even into other States. This insect will therefore be a constant menace to us until it is absolutely exterminated from the land.

Respectfully submitted,

C. H. FERNALD.

Workers destroying masses of gypsy moth eggs on rocks and ledges, showing costly work that must be done in badly infested forest parks.

FIELD DIRECTOR'S REPORT.

To the Committee on the Gypsy Moth.

GENTLEMEN:—In submitting this report the director has endeavored to comply with your recent request to present (1) a brief report of the year's work and its results; (2) a condensed report on the present condition of each infested town or city; (3) the causes which have led to the increase of the gypsy moth in the central woodlands; (4) a statement showing how extermination can be accomplished in these woodlands; (5) a record of the progress of extermination; (6) the reasons why, if the gypsy moth is to be exterminated from Massachusetts, larger appropriations must be granted.

THE WORK OF THE WINTER AND SPRING.

In January and February, 1897, the force, numbering one hundred and thirty-four men, was employed mainly in killing the eggs of the gypsy moth in the woodlands most infested, in cutting worthless trees and in otherwise preparing these woods for the summer work.

In addition to pushing exterminative work in all the known colonies, it had been planned to make in 1897 an inspection, wherever needed, of the entire infested territory; but when the desired appropriation for 1897 ($200,000) was cut down by the Legislature to $150,000, this inspection was of necessity given up.

The appropriation became available Feb. 26, 1897. The force was then increased as rapidly as the preservation of its effectiveness permitted, and was mainly concentrated in the localities most infested. The largest force was massed in Saugus. Here and also in the Fells and Mystic woodland,

colonies* work similar to that of January and February was continued, weather permitting, well into the spring.† More than one thousand acres were thus worked. The undergrowth of many colonies in the great pastures of Salem and Swampscott was cut and burned. In former years this winter and spring work of egg-killing and cleaning up has been greatly hampered by delay in the legislative grants; this year the granting of the appropriation at a comparatively early date enabled this work to be much more thoroughly done than it has ever been done before, and with correspondingly satisfactory results.

Experiments in killing Eggs in Stone Walls.

The moths frequently assemble along stone walls. In past years, when the eggs of the moth abounded in these walls, the walls were torn down, and often had to be rebuilt at a heavy cost. Most of this work has now been done away with. When, in 1897, the young caterpillars hatching in a wall congregated upon the shrubbery, close to either side of it, they were destroyed in quantities, together with the shrubbery, by the use of the cyclone burner. Trees close to the wall were cut away. If then any living caterpillars were left they were forced to give up the wall as a gathering place (as they then had to go some distance for food), and were taken later under burlaps on adjacent trees. In cases where full-grown caterpillars resorted to a wall to pupate, they were destroyed by driving the cyclone flame through it.

Experiments made by Assistant Entomologist Kirkland prove that paraffin gas oil, a nearly crude petroleum oil, is destructive, in temperate or warm weather, to gypsy moth eggs. At the suggestion of Supt. C. S. Williams, experiments were made in spraying certain stone walls with this

* Webster defines a colony (under the head of natural history) as a number of animals or plants living together beyond their usual range. In the gypsy moth work the word "colony" has been applied to the moth when it has been found isolated from others of its kind by a belt of uninfested territory.

† The localities referred to here are three great groups of colonies, which have been alluded to in former reports. These groups contain about one thousand acres each. The Saugus colonies centre in the Saugus woods; the Fells colonies, in the Middlesex Fells; the Mystic colonies, to the west of the Mystic lakes in the woods of Arlington, Winchester, Lexington and Woburn.

cheap crude oil, delivered from a cyclone burner, but not ignited. The oil penetrated the crevices in the walls and destroyed the eggs hidden there. These experiments were so satisfactory that it will be desirable to continue them on a larger scale.

Burlapping.

The early date when the appropriation became available permitted the purchase of burlap in advance of the rise in prices, caused by the new tariff. About one thousand dollars was thus saved.

In April and May burlap was cut up, sent into the field and applied to the trees in infested forest lands where the underbrush had been cleared away. Throughout the whole infested region the most work was done, in the burlap season, where the greatest number of caterpillars were known to be. Every practicable effort was made, however, to destroy, by burlapping, the few caterpillars still remaining in colonies almost exterminated. This was especially the case in the outer towns.

The unusual amount of rain in June seemed to interfere with the movements of the caterpillars. In many of the large colonies they remained mostly among the leaves and branches, instead of coming down the trunks to the burlaps; therefore, during this month the burlaps were not so effective as usual. In the Saugus woods the caterpillars were shaken to the ground by jarring the trees. They would then crawl up the tree trunks and crowd under the burlaps, where they were crushed by the workers. Had not this method been followed, the trees in many localities would have been completely stripped. Later, when the caterpillars were about to pupate, they resumed their normal habits and crowded under the burlaps. When the moths had all deposited their eggs the burlaps were generally removed, and many eggs clustered under or near them on the trees were destroyed.

Spraying.

During May and June rains unfortunately prevailed, interfering seriously with the spraying, which, however, so decimated the caterpillars that, as a rule, the sprayed trees were not stripped.

Arsenate of barium, used in spraying somewhat more extensively than heretofore, proved less satisfactory than arsenate of lead. This latter insecticide, when mixed with sufficient glucose, maintained its superiority over all others. The best results from spraying were obtained on undergrowth, shrubbery, hedges and low trees.

With the object of devising some mechanical means for reaching the upper limbs of tall trees, models have been made, and one machine has been constructed and actually tested in the field. While it is not difficult to invent such a machine to do effective work on level streets and lawns, no device yet perfected can be used to advantage for spraying tall trees, growing close together on our rugged hillsides. Experiments looking to this end are still going on. Improvements have also been made in hose, couplings, extension poles, pumps and nozzles. A new set of spraying outfits is now being constructed at the headquarters in Malden.

Work of the Fall and Winter.

On account of the rapid decrease of the appropriation, the force was greatly reduced in August, and all work was suspended for two weeks in September. On September 20 the fall work was begun. Inspection and egg-killing were carried on in all the known colonies in Saugus woods, and all of those in the towns to the north and east of Saugus. When this was finished the men employed in the eastern division were concentrated in Saugus, where an inspection of the residential portion of the town was begun, and this was nearly finished when, the appropriation being nearly exhausted, the men were discharged. In October a rapid inspection of Malden, most of which could not be burlapped during the summer, was begun, and the greater part of the eggs there were destroyed. Some of the nearly exterminated woodland colonies in the outskirts of the western part of the infested region were thoroughly examined, and some inspection was made of territory outside the limits of known infestation. Nearly three-fourths of the men were then concentrated and employed in egg-killing in the Middlesex Fells region. Early in December, the appropriation being nearly expended, the work was stopped; therefore, although

enormous quantities of the eggs of the moth were destroyed in these woods in November, nearly all the good weather of December was lost. This was a great misfortune, for it has left this excellent work but little more than half done, and it will now be a difficult task to complete it before the eggs hatch in the spring.

Summary of the Year's Work.

The figures given below represent such proportion of a year's work as can be accurately tabulated. The trees were mainly cut on the 1,010 acres of land, where the underbrush was cut and burned. The buildings, fences and other structures which are reported as infested were merely harboring or hiding places of the moth. Usually the eggs were found upon, about or underneath these structures.

It will be noticed that no figures giving the number of the trees found infested or the numbers of the different forms of the moth destroyed appear in these tables. This may be explained as follows: —

Every effort has been made in the field work to economize time and material, wherever it could be done without interfering with the efficiency of the work. In woodlands most infested, especially in the Middlesex Fells region, only enough trees were marked to indicate the presence of the moth. This was a great saving of time and white paint, but it made a correct record of the number of trees found infested in these colonies a practical impossibility. Where only one tree in twenty was marked as infested during 1897, no accurate account of infested trees could be made. This invalidated the entire record of infested trees, and the time ordinarily taken to count and record them has been saved.

The record of the number of caterpillars and other forms of the moth taken is not given, for in one or two of the most densely infested localities the caterpillars were found in such masses that any attempt to count them would have been a great waste of time. Furthermore, it was necessary to destroy them immediately, to prevent their spreading. In many other colonies spraying was almost entirely depended upon to destroy the caterpillars. In other cases spraying and fire were used to destroy the caterpillars and

the eggs. Many trees were cut down and burned with the eggs upon them. Therefore the number of different forms of the moth destroyed during the year cannot be correctly stated; but the records of moths killed in the outer towns are very accurate, and enough has been learned from the figures taken to show that approximately ninety-five per cent of the different forms of the moth were killed in Medford and Saugus woods and in adjacent territory.

Work Done.

Trees (fruit, shade and forest): —	
Inspected (number of times),	12,202,692
Burlapped,	1,117,628
Banded with insect lime,	4,715
In which cavities have been cemented or covered,	1,949
Sprayed,	21,479
Scraped,	1,401
Trimmed,	81,545
Trimmed for burlap,	39,615
Cut,	279,101
Cutting and burning: —	
Acres of brush and shrubbery cut and burned,	1,010
Acres of ground burned over with oil,	62
Acres of ground burned over without oil,	122
Buildings: —	
Inspected,	12,998
Found to be infested,	1,138
Wooden fences: —	
Inspected (rods),	72,652
Found to be infested,	1,150
Stone walls: —	
Inspected (rods),	18,534
Found to be infested,	596
Burned out (rods),	1,683

False Alarms.

During 1897, as in former years, reports of the presence of supposed gypsy moths or of injury caused by them have been received from towns within the infested region and from other towns in the State; but in no such case has any evidence of the moth been found by our investigation outside of the region previously known to be infested, except in Lincoln.

Towns and Cities that have been falsely reported as infested by the Gypsy Moth in 1897.

Barnstable,	Methuen,	Wellesley,
Danvers,	Natick,	Wenham.
Dennis,	Newton,	
Fitchburg,	Plympton,	Hebron, N. H.
Haverhill,	Quincy,	Haverhill, N. H.

Number of Employees in 1897.

The figures given below do not fully represent the number of employees on the pay roll, which at the height of the season reached nearly four hundred, but give the number of those actually at work each week: —

Jan. 1-Jan. 2,	134	June 28-July 3,	352
Jan 4-Jan 9,	133	July 5-July 10,	343
Jan. 11-Jan. 16,	135	July 12-July 17,	339
Jan. 18-Jan. 23,	144	July 19-July 24,	333
Jan. 25-Jan. 30,	144	July 26-July 31,	328
Feb 1-Feb 6,	150	Aug. 2-Aug 7,	324
Feb. 8-Feb. 13,	151	Aug. 9-Aug. 14,	324
Feb. 15-Feb. 20,	151	Aug. 16-Aug. 21,	207
Feb 22-Feb. 27,	152	Aug. 23-Aug. 28,	204
March 1-March 6,	164	Aug. 30-Sept. 4,	202
March 8-March 13,	164	Sept 20-Sept. 25,	201
March 15-March 20,	249	Sept. 27-Oct. 2,	188
March 22-March 27,	249	Oct 4-Oct. 9,	188
March 29-April 3,	354	Oct. 11-Oct. 16,	189
April 5-April 10,	354	Oct. 18-Oct. 23,	184
April 12-April 17,	368	Oct. 25-Oct. 30,	184
April 19-April 24,	383	Nov. 1-Nov. 6,	182
April 26-May 1,	370	Nov. 8-Nov. 13,	183
May 3-May 8,	371	Nov. 15-Nov. 20,	183
May 10-May 15,	371	Nov. 22-Nov 27,	179
May 17-May 22,	360	Nov. 29-Dec. 4,	175
May 23-May 29,	360	Dec. 6-Dec. 11,	173
May 31-June 5,	361	Dec 13-Dec. 18,	29
June 7-June 12,	353	Dec. 20-Dec 25,	29
June 14-June 19,	353	Dec. 27-Dec. 31,	48
June 21-June 26,	352		

The Present Condition of the Infested Region.

To give an absolutely accurate report of the condition of the infested territory is impossible, unless the whole region has been gone over within the year. The report given below indicates mainly the condition of the known colonies. For the following reasons the clearing of the moth from any new towns cannot this year be reported: —

1. Because of insufficient means, the greater part of the work had to be confined to the central towns (more especially within the Middlesex Fells and the Saugus woods), where it was of the first importance to prevent, by a general destruction of the moths, their conveyance from these central colonies back into territory wholly or nearly cleared.

2. There has been during the year no thorough inspection of all the territory of the outer infested towns.

Arlington.

The condition of Arlington appears better than at any time since the work was begun in 1891. Only a few caterpillars were found in 1897, in the most easterly part of the town. The wooded section in the northern portion, in which some of the worst infested colonies have been found since 1891, was burlapped during the summer and inspected. Although the number of men which could be spared for the work was inadequate, the condition of this woodland is now greatly improved. Comparatively few egg-clusters have been found there. Only one of the woodland colonies appeared to be much infested in 1897, and but few caterpillars have been found elsewhere in the Arlington woods this year.* Many of the estates formerly infested have produced no moths this year, and only here and there along the roads have occasional moths been found. A few orchards are still considerably infested. Little except burlapping and other necessary summer work in known infested localities has been done in Arlington for the past three years. It is some time since the entire town was thoroughly inspected. In 1897, however, most of the town was covered either during the burlapping season or afterward.

* The phrase "this year," as used in this report, refers exclusively to 1897.

Belmont.

In many of the old colonies in Belmont no form of the gypsy moth has been found for two or three years, In these colonies the moth has been, no doubt, exterminated. Although in the infested places and their vicinity the trees have been well burlapped and carefully watched during the summer, very few caterpillars have been found except in the hill section to the west of the centre of the town. Here, among the shrubbery and trees on several highly cultivated and valuable estates, a good many caterpillars were taken. On the north side of the town, along both sides of Pleasant Street, several farms are still somewhat infested, and there are also a few small colonies near the Cambridge line; elsewhere the town contains few moths, so far as known. A few egg-clusters were found in the fall in the Beaver Brook reservation of the metropolitan park system, near the Waltham line.

Beverly.

No gypsy moths have been found in Beverly for the past two years. All the known colonies appear to have been exterminated.

Boston.

At Orient Heights, East Boston, 577 caterpillars were found early in the season. In all the colonies in the remainder of Boston, including Charlestown, South Boston, Dorchester, Roxbury, West Roxbury and Brighton, only 195 caterpillars were taken, The trees in the East Boston colony were climbed and carefully looked over in the latter part of the summer, and no form of the moth was found at this inspection.

South Boston as a whole has had no tree-to-tree inspection for the past few years. The only colony there known to be infested was burlapped this year, and 42 caterpillars were found. Nothing has been done there since the burlapping season. The place should, if possible, have an inspection in 1898. Only 1 caterpillar was found in the Roxbury district in 1897. No moths were found in Franklin Park this year, although a thorough inspection was made of a greater part of the park. This still further confirms the belief that Frank-

lin Park is now free from the moth. In 1897 no moths were found in Charlestown; 1 caterpillar was found in Brighton, at a place where a large number of teams are stabled. In Dorchester, where 18 bushels of caterpillars were gathered in 1895, only 151 caterpillars were found in 1897.

Brookline.

The two colonies which were found in Brookline in 1896 were quite thoroughly burlapped that season. A few hidden eggs had hatched in 1897 in each of these colonies before the spring inspection was finished. In one, however, the caterpillars were all destroyed early in the season. In the other all were, apparently, destroyed, except in that part of the colony where the inspection and cleaning up was not finished in the spring. There the most of the caterpillars were killed and a few egg-clusters were destroyed in the fall, The cleaning up of this colony was not finished when the men were laid off in December.

A careful survey of the boundary between Newton and Brookline shows that two trees (formerly, but not now, infested) included in one of the Brookline colonies stand just over the line in Newton. A search made in the fall in the northern part of Newton, adjoining Brookline, resulted in the discovery of a male pupa case of the gypsy moth. This discovery is not regarded as significant, but, since Newton borders on the infested region, the city should be carefully watched.

Burlington.

In the colony reported last year as infested a few caterpillars were found in 1897. Altogether 9 caterpillars, 1 pupa and 3 egg-clusters were found in the town. From a small colony in Woburn, near the Burlington line, a few stragglers crossed into Burlington, which accounts for two of these egg-clusters. The continued infestation of Burlington is readily traceable to large teaming operations conducted by one man.

Cambridge.

The tree-to-tree inspection of Cambridge, which was begun in 1896, had to be given up in 1897, in common with other work, on account of the reduction of the appropriation;

therefore only about one-fourth of the city was inspected in this manner. All the known colonies were burlapped and carefully looked after during the summer. Most of the old colonies appear to have been exterminated before 1897. There are still some in which a few caterpillars were found. Only 3 caterpillars were killed in North Cambridge, in a locality where some years since 35,000 egg-clusters were destroyed within a week. There are a few places in Cambridge where numbers of caterpillars were taken. On some of these estates the trees and shrubbery are of such historic value that it is not advisable to destroy them; thus extermination is rendered extremely difficult. The discovery of single caterpillars here and there under the burlap indicates that they are scattering into Cambridge from the central towns.

Chelsea.

In the southern half of the city only a single pupa was found in 1897. Here all the trees in the immediate vicinity of the colonies infested in 1895 were burlapped and carefully looked over. In the northern half of the city caterpillars were found in ten localities. Later in the season a new colony was found on a dumping ground, among some low bushes. Here 2,016 pupæ were found; 94 egg-clusters were also destroyed at the last of the burlapping season.

As Chelsea has in the past been generally infested, and in some sections the moth has been very numerous indeed, the good condition indicated by this report is remarkable.

The entire city had a tree-to-tree examination in 1895, and was quite thoroughly burlapped in 1894 and 1895; but, as Chelsea is immediately adjacent to Everett and quite near Malden, it is to be expected that caterpillars will be carried there through the ordinary channels of traffic and travel so long as these cities remain uncleared.

Danvers.

Gypsy moths have not been found in Danvers within the past three years. The places formerly infested have been examined; but, on account of the traffic between it and the infested towns and also between it and Boston, another inspection soon is desirable.

Everett.

Most of the trees in Everett were burlapped in 1897 and the burlaps attended; although the moths are still widely distributed through the city, considerable progress has been made since 1896. In that year 462,477 caterpillars were taken under the burlap. In 1897 only 152,202 were taken in the same manner. A thorough inspection of the city should now be made, and all the eggs killed before hatching time.

Lexington.

The colonies formerly known in East Lexington and Lexington Centre, on both sides of Massachusetts Avenue, are now apparently exterminated. This appears to be true also of the scattered colonies on the farms, for in most of these no caterpillars have been found during the summer. Only 3 caterpillars have been found on Massachusetts avenue during the summer, where formerly many thousands were found. The large woodland colonies in the eastern part of the town, formerly so badly infested, are now in far better condition. One tract of about twenty acres has been cut off by the owners and burned over by your agents. No caterpillars have been found since on this tract. Much of the adjacent woodland, which in the past has been considerably infested, has been burned over by forest fires. Infested portions of this woodland have been burlapped and inspected during the summer, and in nearly all of them but few caterpillars have been found. The fall inspection has revealed but few egg-clusters. Only one of the large wood colonies in the north of Lexington has been found infested this year, and in that only 101 caterpillars were killed on a few trees.

The town had a tree-to-tree inspection in 1895; since that time all the colonies which had not then been exterminated have been very carefully worked.

Lincoln.

July 13, 1897, a colony was reported from Lincoln. It was situated less than a mile from the boundary of Waltham, the nearest town in the infested region as heretofore known.

Here the caterpillars had already stripped the trees on about a half acre of ground in the edge of a strip of woodland, and many were travelling north and east across a grass-grown field, eating the grass as they went. The owner, seeing there were two or three caterpillars on each stalk of grass, immediately cut it and saved part of the crop. The owner of the woodland set men at work gathering the caterpillars and pupæ in baskets, and burning them in fires built for that purpose. Your agents were soon on the ground, and began destroying the caterpillars with the cyclone burner. They were swept and shaken from the trees and burned, until few could be found in the centre of the colony. In the meantime, those in the field had left the grass as soon as it began to dry in the sun, and, crossing the field, swarmed into the trees and undergrowth on a wooded hillside. Here their progress was arrested by the cyclone burner.

An inspection of the country in the vicinity was begun in August. As the colony was near the southern boundary of Lincoln, the northern part of Weston, which adjoins Lincoln, was inspected, but no indications of the moth were found there. In a later inspection of the territory immediately about the colony a few egg-clusters were found just over the Lincoln line in Weston. Continued inspection has enlarged the known area of the colony, and it is now known that the moths are scattered half a mile to the north and east from the centre. This inspection was brought to a close by the cessation of field work in December, and should be finished as soon in 1898 as the weather conditions will permit. The vast number of caterpillars found here, their distribution over so large a territory, and other signs of long occupation, all indicate that the colony has been established for several years. The owner of the infested property has lived in Cambridge during the winters, and has driven back and forth in the summers when the gypsy moth was most numerous in that city. In all probability this colony was established at that time, or before the work of exterminating the gypsy moth was begun. The situation of the colony at some distance from the main road explains why it was not found in the roadside inspection of Lincoln made some years ago. Had it been possible earlier

to make a tree-to-tree inspection of Lincoln and the other towns around the boundary of the infested region, this colony would long since have been discovered.

Lynn.

Previous to 1897 more than 1,200 estates in the city proper had been found infested; but this year 7 caterpillars, found on seven widely scattered trees, a few caterpillars killed in another locality and a few egg-clusters found in the fall inspection, constitute all the finds recorded. The known colonies in the Lynn woods have been very much improved in condition, and some of them have been nearly if not quite exterminated this year. The chief difficulty in exterminating the moth from this great forest park is that it is not advisable to use there those drastic and sweeping measures which are so effectual in woodland colonies. Nevertheless, as the moths are decreasing year by year, it seems probable that they can be exterminated from the Lynn woods by the methods now in use. Owing to a lack of means, a large portion of this woodland has not been examined for several years. Although no colonies are known in that portion, its nearness to the badly infested Saugus woods makes it probable that small colonies will be found there on inspection.

Lynnfield.

All the colonies discovered in 1891–92 in the orchards and along the roads of Lynnfield were exterminated three years ago. A later inspection of the woods resulted in the discovery of a considerable number of large and dangerous colonies. The work of the last three years has much reduced these colonies, and some of them now appear to be exterminated. This is true also of one discovered in the woods of northern Lynnfield, near the Reading line, in 1896. Two colonies recently found on the roads have been carefully worked this year, but will need to be watched for at least two seasons. There were found under the burlap in Lynnfield, in 1896, 15,084 caterpillars and 22,022 pupæ; in 1897 the burlapping was more extended, but only 194 caterpillars and 81 pupæ were found.

Malden.

It was reported in 1896 that for several years very little injury had been done by the gypsy moths to the foliage in Malden. Still less injury was done in 1897, but, as only a small portion of the city was burlapped, the moths increased in number considerably during the summer. Most of the city was rapidly gone over in the fall, and all the eggs seen in this rapid inspection were destroyed. Although the eggs are not now very numerous anywhere, the city is, as last year, generally infested, and it is probable that no advance toward extermination has been made in Malden by the work of this season. Situated in the centre of the infested region, Malden has been perforce neglected. Most of the trees should be burlapped in 1898, and everything possible should now be done to exterminate the moth there, as otherwise it cannot be prevented from spreading into the neighboring towns.

Marblehead.

The gypsy moth has been found in 1897 in only one locality in Marblehead. This colony was mentioned in the last annual report. All eggs which could be found were destroyed in the spring. The eggs were distributed along a stone wall overgrown with underbrush, and a few caterpillars hatched from scattered eggs in the wall and from eggs hidden in hollow trees. The undergrowth along the wall was then burned and the trees burlapped. Only two egg-clusters were found in the fall. The entire town had a tree-to-tree inspection in 1896-97. It now needs an occasional inspection to prevent its becoming reinfested.

Medford.

Medford, where the moth was first introduced into this country, is situated near the centre of the infested district, and is now, as in 1891, the place most infested of all the region. The centre of infestation, however, has changed from the residential and business portion, in which much restrictive work has been done, to the woodlands of the Middlesex Fells. There the moth has hardly been held in check by all

the work which could, under the circumstances, be done. More egg-clusters still remain there than are to be found anywhere else in the infested region. Those sections of the city where the moths were known to be most numerous, including the Middlesex Fells colonies, were burlapped in the spring. These burlaps were as well attended as could be expected by the twenty-five men allotted to Medford. Although the work done during the summer failed to hold the moth in check in the woods, it kept the borders of the woodland roads quite clear from the pest, and there were only two or three localities where the trees were stripped. The concentration of nearly three-fourths of the entire force in these woods during October and November has made it possible to put them in better condition than they otherwise would have been, but there are several colonies in which the eggs on the trees have not yet been destroyed. This work and that of preparing the woodland colonies for the work of next summer would employ 100 men from Jan. 1, 1898, to the hatching season, while burlapping, spraying, egg-killing and other absolutely necessary work would keep them very busy for the remainder of the year.

Melrose.

The northern half of Melrose was burlapped in 1896 and 1897. Few caterpillars were found in 1897. South of the centre of the town no work was done in 1896, except an inspection of the residential part in the fall. This part of the town was, however, burlapped in 1897. It was found that the number of the moths had increased considerably, especially in the woodlands near the Malden line; but their number was greatly reduced by the work of the burlap season. Effective work was done in several colonies in that part of Melrose which is located in the Middlesex Fells reservation, and on the later inspections of the burlaps few caterpillars were found. The general condition of the town is now better than in any previous year. In many of the places now marked as infested only single caterpillars were taken. The position of the town, lying, as it does, with the badly infested woods of Saugus on the east, Malden on the south and

the Middlesex Fells on the west, will render it impossible to keep the moths out so long as they are numerous in the adjacent woodlands.

Nahant.

No gypsy moths have been found in Nahant for more than two years.

Peabody.

The gypsy moth is believed to be exterminated from all the old infested localities in the centre of Peabody, and in only three of the woodland colonies have moths been found this year. In one of these, 1 caterpillar was found; in another, only 2. The third—the large woodland colony in the vicinity of Spring Pond which has been so badly infested in years past — appears now to be cleared of the moth; but, on account of its extent, and the fact that caterpillars were found there this year, it must be carefully watched for at least two years. In 1896, 129,408 caterpillars and 379 pupæ were taken there; in 1897, only 458 caterpillars and 14 pupæ were taken. In the summer a colony was found in the central part of the town, which had become infested since any work had been done there. This colony has since been cleaned, but will require careful watching another year.

The reduction in the number of the different forms of the moth found in Peabody indicates that a great improvement has been made in the town.

Reading.

In 1896 no living form of the moth was found in Reading, but in the winter of 1896-97 one hatched egg-cluster and one dead pupa were found on a farm north of the centre of the town. This place was burlapped in the summer of 1897, and 10 caterpillars and 13 pupæ were found there. No form of the moth was found elsewhere in Reading.

Revere.

The only considerable tract of woodland in Revere adjoins Malden and Saugus, and is situated near Franklin Park. This tract had never been thoroughly worked over until

1897, and it was here that most of the moths found were killed. These woods became infested because of their nearness to infested woods just over the line in Saugus and Malden. Early in the season this tract was looked over and a considerable portion of the underbrush cut out and burned. The trees were burlapped and attended through the summer.

Although the town has had no inspection during the fall, winter or spring for several years, most of the residential portions, including all the known colonies outside of the woodland before mentioned, were gone over either in 1895 or 1896, and for three years nearly all the trees in town have been burlapped each summer and well attended, so that it has been kept in excellent condition; but its situation is close to the central infested towns, and thousands of people travel from them to the Revere beaches during the summer. On this account the moth will probably be found in Revere so long as the central towns continue to be infested.

Salem.

All but two of the old colonies in the business and residential part of Salem appear to have been exterminated. In one of these colonies all the eggs which were found in the winter of 1896-97 were destroyed. In the summer of 1897 caterpillars were taken here. In the fall inspection two egg-clusters were found in the other colony.

In the Salem pastures many colonies of gypsy moths have formerly been found. The vegetation on this tract consists largely of red cedar interspersed with hard-wood trees, and the ground is overgrown with barberry bushes and ground juniper. The density of this growth renders a thorough search for eggs impossible, but the young caterpillars can readily be found on the low foliage. A search of a large portion of the pastures was made during the spring, and wherever caterpillars were found most of the trees were cut and the ground and undergrowth burned over with oil. Apparently this has exterminated the caterpillars from most of these pasture colonies; but this region will need a careful watching for some years.

Most of the different forms of the moth found in Salem in 1897 were taken in the pastures.

Saugus.

In years past a number of moth colonies have been found in the villages of Saugus and along the roads. These were worked and closely watched for two or three years. A later discovery of the woodland colonies made it necessary to devote to the woodland much of the time formerly given to the villages. Nothwithstanding the best use that could be made of that part of the appropriation which could be apportioned to Saugus, the woodland colonies have been extending until 1897, when the exigencies of the work necessitated the massing of about one hundred men in Saugus for several months. Nearly all of the infested woods were cleared of underbrush and the dead trees cut out. In some of the worst colonies the live trees were thinned out; in others, the owners cut the wood and the ground was then cleared and burned over. Most of the colonies were thoroughly burlapped. This burlapping was followed up during the summer, with the result that the moths are now nearly exterminated from several of these colonies, and the improvement in the condition of nearly all of them is remarkable. For example, in the five worst colonies 437,150 egg-clusters laid in 1896 and only 40,457 egg-clusters laid in 1897 were taken. There is a portion of the Saugus woodland which has not been inspected for years. This should be inspected during the winter of 1897–98, and any colonies found should be cleared up and thoroughly worked. Another year of such work as has been done in Saugus in 1897 should bring all the large colonies which have been worked this year very near to extermination.

Somerville.

The good condition of Somerville, as reported last year, has been maintained and somewhat improved so far as the known colonies are concerned. There are a few localities in which the moth still hangs on. Only 1,047 caterpillars were taken in the city in the summer of 1897. On account of the proximity of Medford, Somerville must be carefully watched and inspected to prevent reinfestation.

Stoneham.

The village of Stoneham was well burlapped during the summer. Only a few scattered caterpillars were found here and there, except in one or two localities, where a few more were found.

This distribution of single caterpillars, which has been made known by the use of burlaps during the summer, shows that the Middlesex Fells region is a source from which towns near by become reinfested. That portion of the Middlesex Fells which is included in Stoneham has never been seriously infested, except in the south-eastern corner of the town. Several large colonies have been found in past years in the vicinity of the Langwood Hotel, and near the Melrose, Malden and Medford lines. Several have been exterminated and others greatly improved in 1897.

Swampscott.

A few moths have been found this year in three localities not far from the beach. The northern portion of the town, which is more or less wooded and similar in appearance and vegetation to parts of Salem pastures, has never been thoroughly treated until within a year. In the spring of 1897 the trees in this section were thinned out, the undergrowth cut, and where the caterpillars appeared later the ground was burned over. Since then few caterpillars have been taken except in one locality, which should be carefully watched. All but one of the known colonies were inspected in the fall and no egg-clusters were found. Another tree-to-tree inspection would doubtless so complete the extermination of the moth from Swampscott that only an occasional examination would thereafter be needed.

Waltham.

In the only colony known to exist in Waltham in 1896 a few caterpillars appeared in the spring of 1897. This was a large woodland colony, and was carefully looked after during the summer. A search of the entire residential part of the city was conducted early in the fall, but no eggs were found.

Wakefield.

In 1896 the number of known colonies in Wakefield had been reduced to five. In 1897 no moths were found in two of these, but one of the colonies in Saugus woods has extended over the line into Wakefield, and some thousands of caterpillars were taken there.

As all the old colonies in the central and northern part of the town had been exterminated some years since, there has been very little work done there since 1894, when a tree-to-tree inspection of the whole town was made. An examination of the centre of the town was made by one man in November, 1897, and two egg-clusters were found.

Watertown.

The last inspection was begun here in 1896 and finished in 1897, when one small colony was found. This will require to be watched another year. Outside of this colony the moths were found in Mt. Auburn cemetery only, which is partially in Cambridge.

Winchester.

In the residential and business portions of Winchester few gypsy moths were found in 1897. In many of the village estates that have been found infested this year, only one, two or three caterpillars have been found. The caterpillars have been most numerous on the farms in the outskirts of the town, especially in the orchards and woods in the western and southern sections, adjoining Lexington, Arlington and Medford. The worst infested of these woodland districts were cleared of underbrush in the winter of 1896–97 and the following spring, and burlapped. In two or three of the colonies large numbers of the caterpillars were killed, and the numbers of the moths greatly reduced, so that now very few eggs can be found there. In other colonies where many caterpillars were killed in 1895–96 very few were found in 1897. In one of the worst colonies 33 acres of woodland were cut by the owners and the underbrush was burned. Wherever, in this tract, caterpillars were found in the spring, the ground and sprouts

were burned over, and no evidence of the moth has been discovered on this ground since. In another colony, in which caterpillars have been abundant during the past two summers, your agents cut off the wood from about ten acres. The ground here was burned over wherever caterpillars appeared in the spring, and only two egg-clusters have been found in this lot since the burning. In the south-eastern portion of the town, bordering on the Middlesex Fells reservation, is a tract of farm land where there have been strips of badly infested woodland. Most of this was cut or cleared up in the spring of 1897, and vast numbers of the eggs were destroyed by fire. This work and the burlapping of the summer has greatly reduced the moths in this section and prevented their distribution to other parts of the town.

Although Winchester has been more carefully examined during the burlap season than last year, the number of caterpillars killed was much smaller. The numbers killed were as follows: in 1896, 243,639; in 1897, 130,221.

Most of Winchester has been inspected quite thoroughly within three years, either in the burlapping season or during the fall, winter and spring.

As a whole, Winchester is now in better condition with regard to the gypsy moth than it has been at any time during the past few years.

Winthrop.

All the colonies in Winthrop in which any form of the moth was found in 1896 were burlapped in 1897. The trees were climbed and carefully inspected. Only 23 caterpillars and 3 pupæ were found. An inspection of the infested localities was made when the burlap was taken off, but no eggs were found. The entire town was very thoroughly inspected in 1896, and nearly all the trees in the town were burlapped for three years in succession. The results reached are largely due to a liberal use of burlap. The moth appears to be nearly exterminated from Winthrop, but, as there is much driving there during the summer from Malden, Medford and other infested towns, it is probable a few caterpillars will be distributed there annually so long as they are to be found in numbers in these central towns.

Hemlock killed by the gypsy moth in the Saugus woods.

Woburn.

In the residential and business parts of Woburn only a few scattering caterpillars were found here and there during the summer of 1897, with the exception of two localities, where new colonies were discovered in the spring about the time the eggs were hatching. These colonies were thoroughly treated by fire and followed up by burlapping. Another season they will require only careful watching and burlapping. On account of the discovery of these colonies, the number of caterpillars taken in Woburn this year was practically the same as the number taken last year. In the woodland, in the south-west corner of the city, where the largest colonies of the moth had been found in past years, the cutting and burning of infested wood and brush have been extended to the Winchester line. No moths have been found on this tract since. Two wood lots near the Lexington line have also been cut, and no doubt this and other measures will eventually result in the extermination of the moth in that section. The single isolated caterpillars found indicate that they have been redistributed in Woburn during the past summer by such means as originally infested the town. If the moths can now be exterminated from the badly infested centres in the inner towns, which are now reinfesting Woburn and the other outer towns, there will be no difficulty in clearing Woburn of the gypsy moth within a short time.

The Increase of the Moth in the Central Woodlands.

It becomes necessary now to revert to the history of the efforts to exterminate the gypsy moth in former years.

In 1892 your committee ascertained, and then duly reported, that at least 400 acres of central woodland were known to be more or less infested by the gypsy moth, and asked for means sufficient to stamp out the moth from these forested tracts. Furthermore, your committee predicted that, in case sufficient appropriations were not granted, there would be great danger that the insect might extend its hold in these woodlands, with the result that it might be much more difficult to secure its extirpation. Means adequate for the purpose were not then nor afterwards granted.

Your committee has from year to year, as in duty bound, reported that an alarming increase and spread of the moth was progressing in these woodlands, in spite of all the work that could be done to check it with manifestly insufficient appropriations.

In 1895 your committee ascertained and duly reported that the forest infestation of 1892 (400 acres) had increased to 3,000 acres. The increased appropriation granted in 1895 made possible the cleaning up of a small part of these woodlands; but, as the appropriation was greatly reduced and delayed again in 1896, much of the advantage gained by the work done in 1895 was lost. At least 2,000 acres of these woods were found in the winter of 1896–97 to be in a worse condition than ever before. Had this increase and spread been allowed to go on in 1897, no doubt the cost of the necessary exterminative work in these woodlands in 1898 would have been greater than that of handling the colonies in all the rest of the infested region, and in fact greater than any annual appropriation which has thus far been granted.

Methods of Extermination in Woodlands.

It was long since proved that the gypsy moth could readily be exterminated from open and cultivated lands, orchards and shade trees; it has now been abundantly shown that it can be exterminated from the woods. In forest park lands, where it is not advisable to cut away or burn trees, shrubbery and vines, progress has been necessarily slow; but in ordinary woodland extermination has progressed more rapidly. In some cases the wood was cut off by the owner, and, after undergoing a sufficient quarantine, was marketed by him. The brush was then burned, the land cleaned up and the ground burned over. In other cases, where the land was sparsely wooded and more or less grown up to underbrush, it was cleared and burned over. Where the land was valuable for prospective building purposes, it was burned over and nearly cleared, leaving a few of the finer shade trees only; thus greatly reducing the number of trees to be afterwards burlapped and inspected. In other cases the number of trees was

reduced by cutting out only the worthless trees, and the ground cleaned up by removing and burning the underbrush. In certain colonies where the moth had appeared in many thousands, the eggs on the trees were destroyed and the ground burned over with oil. Later the trees were banded with Raupenleim, to prevent the caterpillars ascending, and the few caterpillars which hatched from the eggs remaining on the ground were thus starved. Any one of these methods will bring about extermination, if supplemented by such others as can be used to the best advantage. Extermination here, as elsewhere, must be verified through several years by a thorough search in the summer for the caterpillars and in the winter for the eggs of the moth.

The Progress of Extermination.

All practical entomologists who have followed the work of extermination for the past six or seven years are now convinced that the gypsy moth can be exterminated, and that its extermination, under the present methods, is only a question of time and adequate appropriations. People who hold opposite opinions seem to be impressed by the belief that the gypsy moth is generally distributed over the whole so-called infested territory of more than 200 square miles. This, emphatically, is not the case, nor has it ever been the case. Outside the central towns the moth is found only in isolated swarms or colonies, separated by wide intervals of uninfested ground. In fact, the greater part of the region called infested has never been invaded by the moth. For this reason it is never necessary to make a careful, thorough search over all the territory of the towns in the infested region, for the purpose of discovering single caterpillars or moths. Such scrupulous searching is essential only in and around the known colonies. In seeking for and destroying the moth in these colonies, the greater part of the appropriation has always been expended, and must always be, so long as the moths are numerous. But there should also be, from time to time, a rather rapid search of all the region between the colonies. This should be conducted in the fall, winter and early spring, — when deciduous trees bear little or no foliage, — to provide against the establishment of new colonies.

This search over the entire country is what is called a tree-to-tree examination, and is made, not to find the last caterpillar or the last moth, but to find the last colony. When that is found, careful inspection, burning, spraying, burlapping and other means must be utilized to destroy the last moth in that locality.

When any given locality has been apparently freed from the moth, extermination there must be verified by careful examinations for a term of years before it can be authoritatively announced.

The methods now in use have always exterminated the moth wherever they have been followed without interruption for a reasonable period. A personal examination of the colonies known to have been infested in 1897 leads to the conclusion that much more progress toward extermination has been made this year than in any previous season. Outside the Fells region, except in Malden and Medford, the condition of nearly all the known colonies has been greatly improved by the work of 1897. Against this favorable statement must be set the fact that less inspection than usual has been made in 1897, except in or near the vicinity of the known colonies. The residential and business sections of several of the outer towns were, however, burlapped almost entirely this year, and the burlap carefully inspected. This resulted in the picking up of a stray caterpillar here and there on territory not lately infested. The discovery of such strays does not indicate the local hatching of even a single egg-cluster, but rather demonstrates that the caterpillars have been disseminated by vehicles and pedestrians within the past two years from the large colonies (especially the woodland colonies) in the central towns into territory previously cleared. But, it may be asked, why was not the moth eradicated from these central woodlands while the colonies there were still small, and, therefore, comparatively easy to exterminate? This was not done for the reason that before it could be attempted there were discovered in the woodlands of the outer towns larger colonies which were then in worse condition than were those in the inner towns. As money enough had not been provided to attend to all, it became necessary to attend to the outer towns first, on account of

their position near the border of the infested region. The first duty of the committee, under the law, was to "prevent the spreading" of the gypsy moth; and there was evidently more danger then of the moths spreading from these outer colonies into territory outside the infested region than there was of their spreading into this outside territory from the forest colonies in the central towns.

In summing up the progress of extermination, it may be fairly stated that in the outer two-thirds of the district known as the infested region there remain now only a few known colonies, most of which are on the verge of extermination. From this portion of the infested region the moth now appears to be almost, if not quite, exterminated.

The problem of extermination is now considerably simplified. The large colonies in the woodlands of the outer towns have been either exterminated or so reduced that their extermination is a matter of a short time. Serious danger from this source of the conveyance of the moth into towns beyond the border of the infested region has been eliminated. It is true that the large woodland colonies in the Fells are not improved. But a large force of men, which has heretofore been of necessity scattered in isolated colonies in the outer towns, can now be concentrated nearer the centre of the infested region, in the Fells and Saugus colonies, and in Malden, Medford and Everett, where the work can be more economically supervised and directed.

Why Larger Appropriations are needed.

As it has been already stated that progress has been made with past appropriations, the question may well be asked, Why, then, are larger appropriations now required? It may be answered in brief that we have now reached a time when much more rapid progress must be made, or the success of the whole work will be put in imminent peril. This is clear for the following, among other reasons: —

1. A vast amount of work is immediately required in the central woodlands, where, otherwise, the area now occupied by the moth will greatly increase each year, thereby either greatly increasing the final cost of extermination, or, by the

enormous expense involved, compelling the abandonment of the whole exterminative work.

2. The increased danger of disseminating the moth, due to the constant opening to travel of new paths, parkways, boulevards and trolley lines, leading into and through these woodlands, also makes immediate extermination necessary there.

3. If extermination in these woodlands is to succeed, it must be begun at once, and on a large scale. The work must be of the most thorough nature, and it must be followed up throughout every month of the year.

4.. Much of this woodland has been taken for metropolitan or municipal parks; other large portions are highly valued for prospective building purposes. While cutting and burning all the trees on these forested lands might be in the end the most economical course, such measures need hardly be considered in the case of public parks; there less drastic methods are recommended. If the trees are to be generally preserved there, and it seems that they must be, the extermination of the moth from these lands will be extremely expensive. With larger appropriations in the past, advantage could have been taken of the favorable conditions then existing. The moth could have been readily and rapidly exterminated from the colonies, then comparatively very small, in the central woodlands, and thus, of course, prevented from spreading over the large tracts it now occupies. A great deal of money would thus have been saved in the end.

5. The reduction of past appropriations and the delay in making them has necessitated a repetition of merely partial work year after year in many colonies, deferring their extermination and increasing its ultimate cost three to ten times. The force in not a few instances has been compelled to skip from one part of the territory to another, much as if a fire department, in attempting to control a fierce conflagration with an insufficient number of men, should run about from one outbreak to another, completely subduing none. Under this policy the moth has increased and spread in every place which has been for the time necessarily neglected.

6. Experience demonstrates that the moth colonies cannot be exterminated in detail. On the contrary, if extermination is to succeed, every effort must be made each year to

exterminate all these colonies simultaneously. In the fall of 1897, as in previous years, much work had to be left undone, in order that the most dangerous colonies might be looked to. To do the required work in the Middlesex Fells, it was necessary to neglect for two months all the outer and intermediate colonies in two-thirds of the infested region. It will require a large sum of money to thoroughly inspect these colonies, and destroy, before hatching time, the few egg-clusters still remaining there. To do the required work in the generally infested central woodland and residential territory in Medford, Melrose, Malden, Everett and Saugus, with portions of contiguous towns, will cost a larger sum than has hitherto been used in any year in the entire infested territory.

7. The moth, within the last three years, has shown alarming evidence of increased vigor and fertility, and has suffered little perceptible check from its parasitic or other natural enemies. Unless the moth is stamped out promptly, circumstances favorable to its still further increase may arise.

8. The discovery within the last two years of three colonies of the moth outside of what has been known as the infested region, emphasizes the necessity of another and more thorough examination of all the towns bordering upon it. If an undiscovered extra limital colony has already become established near the infested region, a thorough examination of a belt, two towns wide, outside the boundary of known infestation, would bring it to light. Such an inspection, covering the greater part of 1898 and the two following years, ought to be made. Its cost would be heavy.

Conclusion.

If, through further reduced and delayed appropriations, the moths in the central woodlands should be allowed to increase in numbers and spread over more territory, even though they might be so well held in check there as for a time to do no appreciable injury, it would be but a few years before the annual cost of exterminative work in the woods alone would be greater than all the money heretofore expended in the entire region. It must be borne in mind, too, that, if the central woods are now to be cleared, the residential parts of the towns and cities immediately adjoining these

woods must also be promptly cleared of the moth, in order that infestation may not be carried thence again into the cleared areas both of forest and open country. The money which has been thus far expended in the extermination of the gypsy moth has accomplished much by protecting the orchards, gardens and forests of the infested region, and preventing the spread of the moth throughout the State. It has furnished an object lesson to the citizens who would have to deal with the pest should the Commonwealth fail to support the work. But, if extermination should be further delayed by insufficient support, the money already expended will have been thrown away, so far as accomplishing the end in view is concerned, and in all probability the moth will again occupy, not only the region from which it has been cleared, but in due time the entire State also, from which it will doubtless spread over the United States.

In short, the situation is this: in the outer towns, where extermination has been pushed, it has succeeded; in the central towns, where, because of insufficient means, suppression only could be tried, it has failed. Not only has this enforced policy of mere suppression in the centre resulted in failure, but it has also allowed the moth to spread, thus jeopardizing again the outer towns. It is plain that the only way to prevent the spread of the moth is to exterminate it from the land. Further appropriations can be justified only by a supreme effort to exterminate. No further progress in extermination *in toto* is now possible with an appropriation of less than $200,000. With the large number of experienced men now available, even a larger sum could be used to advantage in 1898. It would be better to give up the work now than to continue it with insufficient appropriations, for in either case the moth will eventually escape and spread over the country. If Massachusetts has not the energy to crush this potent foe to agriculture and forestry while she now has it in the hollow of her hand, — if she cannot now provide ample appropriations for this purpose, — then let not another dollar be expended.

Respectfully submitted,

E. H. FORBUSH.

APPENDIX.

The following papers represent as much of the scientific part of the work for the extermination of the gypsy moth during the past year as has been completed and prepared for publication. The gypsy moth committee have held very broad and comprehensive views concerning both the scientific investigations and the field work, for they recognize the fact that all possible discoveries bearing on the destruction of this insect pest should be made and given to the public. This very wise policy has received the highest commendation from leading scientific men both in this country and in Europe.

C. H. FERNALD.

ARSENATE OF LEAD AS AN INSECTICIDE.

C. H. FERNALD, ENTOMOLOGIST.

In the work of destroying the gypsy moth it was soon discovered that Paris green would not kill many of the caterpillars, even when used in as large a proportion in water as was possible without injury to the foliage of the trees. It therefore seemed necessary to discover, if possible, some insecticide that would destroy the caterpillars and at the same time not injure the most delicate foliage. Mr. F. C. Moulton, who was employed by the gypsy moth committee as chemist, was directed to investigate the various compounds of arsenic, and endeavor to find some substitute for the insecticides then in use which possessed the necessary properties. After a long series of experiments, in 1892 he was so fortunate as to discover arsenate of lead, which certainly possesses the desirable characteristics more fully than any insecticide previously known.

The first public mention of arsenate of lead was made in the report of the Massachusetts Agricultural College, October, 1893, p. 23. In Bulletin No. 24 of the Hatch Experiment Station, Amherst, Mass., published in April, 1894, a more complete account was given of this insecticide and of experiments with it on the tent caterpillar and Colorado potato beetle. Mention was also made of this insecticide under the name of "gypsine" in the report of the gypsy moth committee for 1894, pp. 20 and 35. The name "gypsine" was given to this insecticide by Mr. Moulton, but, as there was an entirely different product on the market by the same name, this insecticide was called arsenate of lead, to avoid confusion. In the report of the gypsy moth committee, February, 1894, p. 20, the announcement of the discovery of arsenate of lead by F. C. Moulton was made by Mr. E. H. Forbush, the field director, and the formula was given. In the same year Prof. James Fletcher, in "Evi-

dence before the Standing Committee on Agriculture," in the Canadian Parliament, pp. 19 and 20, referred to this new insecticide; and again in the report of the Entomological Society of Ontario, p. 71 (1894), he referred to its value. In the seventh annual report of the Vermont Agricultural Experiment Station, p. 123 (1894), Dr. G. H. Perkins, the entomologist, recommended the use of arsenate of lead for the destruction of several different kinds of insects, and gave the formula for making it.

Arsenate of lead was described by Mr. E. H. Forbush, with its effects, value and limitations, in the report of the gypsy moth committee for 1895, p. 16. Mr. C. P. Lounsbury, in Bulletin No. 28 of the Hatch Experiment Station, p. 9 (1895), recommended this insecticide for the destruction of canker worms. In the Massachusetts Crop Report of June, 1895, Mr. A. H. Kirkland gave a general description of arsenate of lead, its cost, etc. In the fifteenth annual report of the New Jersey State Agricultural Experiment Station, p. 400 (1895), Prof. J. B. Smith described arsenate of lead, and recommended it highly for use against the elm-leaf beetle. In the "Proceedings of the Association of Economic Entomologists," p. 24 (1895), Mr. C. L. Marlatt gave an account of this insecticide, with a formula for its preparation furnished by Mr. K. P. McElroy of the Division of Chemistry of the Department of Agriculture, Washington, D. C.

A more complete account of arsenate of lead, with the history of its discovery, uses and numerous experiments performed with it, was given in "The Gypsy Moth," by Forbush and Fernald, pp. 69, 80, 87, 142, 143, 145, 449–473 (1896), and Mr. Forbush gave an account of its use on hedges in the report of the gypsy moth committee, p. 18 (1896). In Bulletin No. 36 of the Hatch Experiment Station, p. 6 (1896), Mr. R. A. Cooley recommended the use of this insecticide against the elm-leaf beetle. In the same year Prof. J. B. Smith, in his "Economic Entomology," p. 436, described and recommended arsenate of lead as an insecticide for leaf-eating insects. In the "Proceedings of the Association of Economic Entomologists" for 1896, p. 27, Mr. A. H. Kirkland gave an account of arsenate of lead; and in the same volume, p. 44, Prof. J. B. Smith referred to the ease with which this

insecticide is prepared. In the proceedings of the same society for 1897, p. 46, Mr. Kirkland gave a full account of the use of arsenate of lead against the gypsy moth.

This insecticide is easily prepared by putting 11 ounces of acetate of lead in 4 quarts of water in a wooden pail, and 4 ounces of arsenate of soda (50 per cent.) in 2 quarts of water in another wooden pail, and when entirely dissolved mixing them in a hogshead containing 150 gallons of water, when a chemical reaction will take place, forming arsenate of lead as a fine white powder in suspension in the water. If cold water be used, the solution of the acetate of lead will require a little time; but, however, if the water be hot, it will dissolve very quickly. It is customary to add from 2 to 4 quarts of glucose to the above amount of water. If it is desired to use larger proportions of the arsenate of lead, it is only necessary to use more acetate of lead and arsenate of soda, but in the proportions given above. A more detailed and exact explanation is given in a following paper by Mr. F. J. Smith.

Arsenate of lead has already proved to be the most valuable insecticide known for the destruction of the gypsy moth. It does not injure the foliage of the most delicate plants, even when used in as large a proportion as 25 pounds, or even more, to 150 gallons of water; in fact, there is no known arsenical insecticide so harmless to vegetation as arsenate of lead. This substance remains in suspension in water much longer than Paris green, because of its very low specific gravity, which is 1.00668, while that of Paris green is 3.42225. In spraying, the low specific gravity of arsenate of lead and its consequent suspension in water for a considerable length of time make it possible to distribute it more evenly over vegetation. The white color is also a decided advantage, for one is able to see at a glance whether a tree or shrub has been sprayed; and it is a noteworthy fact that this insecticide adheres to the foliage far longer than any similar substance now in use.

What has been said with regard to the value of this insecticide for the destruction of the gypsy moth is also true in the case of other leaf-eating insects. In every case where we ourselves have performed experiments on these insects, and in all cases reported by others who appear to understand

the use of it, the most satisfactory results have been obtained. It is undoubtedly true that larger proportions of this substance must be used than of Paris green, but this can be done with entire safety to the vegetation. The cost of the insecticide forms a very small part of the cost of spraying; and since arsenate of lead remains on the foliage so much longer than other insecticides, a much larger proportion can be used and even then be much cheaper than substances which wash off readily in showers, making it necessary to spray the trees a second time.

A large percentage of the spraying done in orchards at the present time is with a mixture of an insecticide and a fungicide; because, as has already been said, the great expense is in the labor, and not in the materials used; and when the insecticide and fungicide can be applied together, the cost of one spraying is saved. We have not experimented as yet with a fungicide mixed with arsenate of lead, but our chemist, Mr. F. J. Smith, informs me that he does not think there will be any reaction between arsenate of lead and the Bordeaux mixture to prevent using them together, but that they may be mixed and used as readily as Paris green and the Bordeaux mixture. Professor Craig, in his report as horticulturist of the Experimental Farms, 1895, p. 119, records excellent results with arsenate of lead against the codling moth, and also good success in using the insecticide and Bordeaux mixture together.

Spraying may almost be regarded as a fine art. Not every one of those even who have had a long experience at the work can spray a tree properly. I have repeatedly examined trees which had been sprayed by those who considered themselves experienced hands at the work, and found the leaves so wet that the water was dripping from them or standing on the surface in such quantity that the poison was settling on the lower part, where it either ran off, or, when the water evaporated, the poison was confined to a fractional portion of the leaf. Spraying should be done with a nozzle that gives only a fine, mist-like spray, and should be stopped before it runs on the leaves. This is more easily said than done, but we often find men who seem to catch the idea, and stop at the exact time.

ARSENATE OF LEAD: ITS MANUFACTURE AND CHEMICAL COMPOSITION.

FREDERIC J. SMITH, M.S., CHEMIST TO THE COMMITTEE.

The value of arsenate of lead as an insecticide has been fully set forth in the preceding paper by the entomologist. Since this insecticide has come into such general use, the present seems a proper time to place on record the essential facts concerning the ingredients used in making arsenate of lead, the chemical reactions that are involved and the exact composition of the final product. The results of our work will, it is hoped, be all the more serviceable to economic entomologists because it is apparent that the preparation of this substance has not been generally understood, as is shown by several erroneous and conflicting statements which have been published concerning this subject.

To be exact, the arsenate of lead used in spraying operations is not a salt whose composition may be definitely expressed by a single formula, but instead is a mixture of both di-plumbic and tri-plumbic arsenates, the relative quantities of each depending principally upon the source of the soluble lead salt used. Since the term "arsenate of lead" has now become so well established, it will be used in its general sense in the present paper.

INGREDIENTS.

Theoretically, in the preparation of arsenate of lead it is only necessary to form a chemical union between the common lead oxide (litharge), PbO, and arsenic pentoxide, As_2O_5; but, in order to obtain a product suitable for use as an insecticide, the chemical union must take place between soluble salts containing these oxides. In general practice, arsenate of lead suitable for spraying purposes is prepared by bringing together commercial grades of acetate or nitrate

of lead and arsenate of soda. Owing to the variable composition of these commercial salts, a chemical analysis of each is indispensable, as indicating the relative amounts to be used. All such calculations must be based upon the quantity of lead oxide (PbO) found in the lead salt and that of arsenic pentoxide (As_2O_5) contained in the arsenate of soda, making due allowance for other acidulous radicals which may precipitate the lead.

Both the acetate and the nitrate of lead are extensively used in paint and dyeing industries, and especially as mordants in calico printing. Arsenate of soda is chiefly used to remove mordants.

Acetate of Lead, Lead Acetate, Sugar of Lead.

$Pb(C_2H_3O_2)_2 3H_2O$.

So far as is known to the writer, this salt is the one generally used as a source of soluble lead oxide for the preparation of arsenate of lead. Acetate of lead may be obtained in the market in all grades, from clear, transparent crystals to dark gray or brown lumps, and is usually quite free from adulteration. It is prepared either by exposing litharge (PbO) to the action of the vapors of pyroligneous acid, or by dissolving metallic lead in pyroligneous acid and recrystallizing the products from water solutions. Pure lead acetate crystallizes in four-sided prisms, containing three molecules of water of crystallization. Crystals formed by the sudden cooling of a hot saturated water solution separate in a more finely divided condition than those formed by a slow evaporation. The finer crystals are especially desirable when the salt is to be used for technical purposes, or when it is necessary to dissolve a large quantity in a short space of time.

When the crystallized salt is exposed to the action of the air there is a rapid loss of water of crystallization (efflorescence) and also a slow formation of lead carbonate, due to the action of carbon di-oxide contained in the air. Thus the percentage composition of crystallized lead acetate may be materially changed. Loss of weight by efflorescence yields a product containing a higher percentage of actual lead acetate than the original crystallized salt, accompanied by

an increase of insoluble lead carbonate. The increase in the percentage of lead acetate that accompanies efflorescence is well illustrated by sample No. 4 of Table No. 1. Pure crystallized lead acetate contains 58.81 per cent. of lead oxide; but this sample, which had been exposed to the air in a loosely covered vessel for over six months previous to analysis, yielded 66.795 per cent. of lead oxide. The following table indicates the amounts of available lead oxide contained in different market grades of acetate of lead: —

Table No. 1.

SAMPLE.	Percentage of Lead Oxide (PbO).
No. 1, crystallized acetate lead, from drug store, . .	59.525
No. 2, crystallized acetate lead, from drug store, . .	61.548
No. 3, crystallized acetate lead, from drug store, . .	60.650
No. 4, crystallized acetate lead (effloresced), . . .	66.795
No. 5, "chemically pure white acetate lead powder," from wholesale chemist.	62.500
No. 6, "white acetate lead granulated," from wholesale chemist.	60.800
No. 7, "white acetate lead lumps," from wholesale chemist,	60.550
No. 8, "brown acetate lead," from wholesale chemist, .	62.290

Samples Nos. 1, 2 and 3 were supposed to be chemically pure. No. 4 has been previously described. No. 5 is somewhat more expensive than the other market grades, is in a very finely divided condition and dissolves very readily in water. No. 6 is the grade used last year by the gypsy moth committee for the preparation of arsenate of lead. This salt contains many lumps, which consist of finely divided crystals. These lumps dissolve readily in cold water. No. 7 dissolves slowly in cold water, but easily in hot water. No. 8 contains a considerable amount of tarry matters and a small quantity of basic acetate of lead. In handling any of these salts, proper care should be taken to avoid inhaling their dust. Lead is a "cumulative" poison, and when once absorbed is with difficulty eliminated from the system.

Nitrate of Lead, Lead Nitrate, Lead Saltpetre.

$Pb(NO_3)_2$.

The comparative cheapness of this salt first suggested its possible value for the preparation of arsenate of lead. Experiments made during the summer of 1897 indicate that arsenate of lead prepared from the nitrate also possesses properties quite as important as the lower market price of the latter salt. The grade of this salt most common in the market varies somewhat in its chemical composition. It is prepared by dissolving "lead scale" or litharge (PbO) in hot dilute nitric acid; upon evaporation, the nitrate of lead crystallizes out in transparent octohedral crystals. Lead nitrate has the advantage of containing a high percentage of lead oxide. In the reaction between lead and nitric acid there is a tendency toward the formation of basic salts, and the commercial lead nitrate usually contains a higher percentage of lead oxide than the chemically pure crystals. Lead nitrate is not affected by exposure to the air, and does not dissolve in water as readily as the acetate. The results obtained from the analyses of three samples of lead nitrate are given in the following table: —

Table No. 2.

SAMPLE.	Percentage of Lead Oxide (PbO).
No. 1, nitrate of lead, from drug store, ...	68.37
No. 2, nitrate of lead, from drug store, ...	67.76
No. 3, nitrate of lead, from wholesale chemist, . . .	66.37

Arsenate of Soda, Arseniate of Soda, Di-sodic Arsenate, Hydrodi-sodium Arsenate.

$Na_2HAsO_4(H_2O)^n$.

Aside from the mono-metallic arsenates, the soluble salts of arsenic acid are limited to those of the alkaline metals. Of the latter, the arsenates of potash and ammonium are

rarely met with, and have but a limited use in medicine; while sodium arsenate, from its abundance in the market and low cost, is the only one that may be profitably considered as a source of soluble arsenic acid. Several grades of this salt, containing from 50 to 75 per cent. of arsenate of soda, are found in the market.

The sodium arsenate of commerce was formerly prepared by dissolving common white arsenic in a hot solution of caustic soda, with the addition of a sufficient quantity of sodium nitrate, the whole being evaporated to dryness and fused, when the sodium arsenite became oxidized to sodium arsenate. At the present time, commercial arsenate of soda is chiefly produced as a secondary product of the German aniline industries. I am informed by Mr. John S. Rigby, F.R.S., of Liverpool, that English manufacturers of sulphuric acid are now using white arsenic in the place of sulphuric acid for decomposing nitrate of soda in the nitre pots, and are thus producing arsenate of soda as a by-product.

The pure crystallized salt sold by druggists is prepared by dissolving the crude arsenate of soda in water and concentrating the solution, when di-sodium arsenate having the formula $Na_2HAsO_47H_2O$ crystallizes out.

Pure di-sodium arsenate is isomorphous with di-sodium phosphate, and possesses almost identical physical and chemical properties. Under ordinary conditions di-sodium phosphate crystallizes with 12 molecules of water, but di-sodium arsenate crystallizes with 12 molecules of water only when the solution is evaporated and crystallized below the temperature of 18° C. (Fresenius, J. pr. Chemie 56, 30.) In discussing the preparation of arsenate of lead Mr. K. P. McElroy unfortunately overlooked the fact that the arsenate of soda containing 12 molecules of water is quite unsuitable for the purpose, and hence the directions given by him ("Proceedings of the Association of Economic Entomologists," 1895, p. 24) are misleading. The amount of water in the commercial salt is dependent upon its manner of preparation and care in storage. All the commercial grades contain less water of crystallization than the crystallized salt, $Na_2HAsO_47H_2O$, commonly sold by druggists, and when

the composition of the commercial salt is expressed as a formula, the water present may be written as $(H_2O)^n$, where n = the number of molecules of water.

The most economical grades of arsenate of soda for the preparation of arsenate of lead are those containing the highest percentage of arsenic pentoxide, As_2O_5, and the least amounts of chlorine and other foreign substances. A high percentage of arsenic acid alone is not necessarily indicative of the purity or value of the salt. The great variation in the composition of the different grades of arsenate of soda is exhibited in Table No. 3, and is probably due to different processes of manufacture, and possibly, in the case of the first sample, to adulteration with salt (NaCl).

Table No. 3.

CONSTITUENTS.	Sample No. 1.	Sample No. 2.
	Per Cent.	Per Cent.
Water at 200° C.,	7.73	26.72
Chlorine,	17.81	2.60
Arsenic pentoxide (As_2O_5),	39.69	45.39
Sodium oxide,	14.03	15.07
Sodium as chloride,	11.54	1.70
Potassium oxide,	6.02	7.63
Insoluble matter,	1.87	.19
Sulphates and nitrates (estimated),	1.31	.70
	100.00	100.00

Sample No. 1 is known to the trade as "50 per cent. arsenate soda," and is sold at a lower price than the "65 per cent. arsenate soda" represented by sample No. 2. For the preparation of arsenate of lead it will suffice to determine the amounts of arsenic pentoxide and chlorine present in the arsenate of soda. Determinations made from four representative samples of arsenate of soda follow: —

Table No. 4.

SAMPLE.	Arsenic Pentoxide.	Chlorine.
	Per Cent.	Per Cent.
No. 3, chemically pure crystals, from drug store, .	36.86	-
No. 4, chemically pure crystals, from drug store, .	36.77	-
No. 5, commercial, 58 to 60 per cent., . . .	37.70	.75
No. 7, commercial, 68 to 70 per cent., . . .	47.80	.57

*The Presence of Chlorine in Arsenate of Soda.**

There are probably no commercial grades of arsenate of soda wholly free from chlorine but its presence to the amount of 2 or 3 per cent. does no serious harm. If chlorine be present to a greater extent than 4 or 5 per cent., upon the addition of the soluble lead salt to the impure arsenate of soda a considerable quantity of chloride of lead will be precipitated. This but wastes the soluble lead salt, since chloride of lead has practically no value as an insecticide. The reaction in this case may be expressed by the following equation: —

$$Pb(C_2H_3O_2)_2 3H_2O + 2NaCl = PbCl_2 + 2NaC_2H_3O_2 + 3H_2O.$$

The solubility of lead chloride in water at 20° C. is .9712 part to 100 (Formanck), and in hot water 1 part to 22 (Wittstein).† The arsenate of lead should be precipitated in a dilute solution, and where possible, brook or hydrant water should be used in preference to colder spring or well water.

Arsenate of Lead, Lead Arsenate.

Arsenate of lead may be prepared by mixing a solution of arsenate of soda with a solution containing either acetate or nitrate of lead. As previously stated, it consists of a

* Several other impurities, such as arsenious acid, sulphates, nitrates, etc., also occur in commercial arsenate of soda. The arsenious acid, upon the addition of a soluble lead salt, is precipitated as arsenite of lead, which possesses considerable value as an insecticide.

† A. M. Corney, "Dictionary of Chemical Solubilities," 1896, p. 206.

mixture of the di-plumbic and tri-plumbic arsenates, their relative proportions varying according to the conditions of temperature and concentration at the moment of precipitation.

Where the acetate of lead is used approximately, the whole of the arsenate of lead product consists of tri-plumbic arsenate, as indicated by the following reaction: —

$$3Pb(C_2H_3O_2)_2 3H_2O + 2Na_2HAsO_4(H_2O)^x =$$
$$Pb_3(AsO_4)_2 + 4NaC_2H_3O_2 + 2C_2H_4O_2 + {}_x(H_2O).$$

In order to prepare arsenate of lead successfully, great care must be taken to establish an exact ratio between the quantities of the soluble lead and arsenic salts, otherwise injury to the foliage may result. The reaction between acetate of lead and arsenate of soda may be summarized as follows: —

$$3PbO + As_2O_5 = Pb_3(AsO_4)_2.$$

One part $Pb_3(AsO_4)_2$ requires .74416 part PbO and .25584 part As_2O_5. Experience has shown that it is advisable to increase the amount of lead oxide to .77812, in order to insure an excess of lead. A single example will suffice to show how the relative amounts of soluble lead and arsenic salts may be fixed.

Let it be required to prepare 1 pound of arsenate of lead from samples of lead acetate (X) and sodium arsenate (Y), containing respectively 60 per cent. lead oxide (PbO) and 40 per cent. arsenic pentoxide (As_2O_5): —

$$X = \frac{.77812}{.60} = 1.2969 \text{ pounds lead acetate.}$$

$$Y = \frac{.25584}{.40} = \ .6396 \text{ pound arsenate of soda.}$$

Should the arsenate of soda contain 7 per cent. chlorine, in addition to the arsenic pentoxide, there would be required an additional amount of lead acetate (Z) to complete the reaction between the two salts. One part chlorine is equivalent to 3.1408 parts PbO, and the amount of lead acetate required is determined as follows: —

$$Z = \frac{.6396 \times .07 \times 3.1408}{.60} = .2343 \text{ pound lead acetate.}$$

Adding the values of X and Z, we find that 1.5312 pounds lead acetate are required for the reaction with .6396 pound arsenate of soda of the grade specified. Expressing these quantities in avoirdupois weights, 1 pound arsenate lead requires 1 pound 8½ ounces acetate of lead and 10¼ ounces arsenate soda.

The following equation represents the reaction between arsenate of soda and nitrate of lead: —

$$5Pb(NO_3)_2 + 4Na_2HAsO_4(H_2O)^x =$$
$$Pb_3(AsO_4)_2 + 2PbHAsO_4 + 8NaNO_3 + 2HNO_3 + x(H_2O).$$

The essential features of this reaction may be summarized as follows: —

$$5PbO + 2As_2O_5 + H_2O = Pb_5H_2(AsO_4)_4.$$

One part $Pb_5H_2(AsO_4)_4$ requires .70 part PbO and .30 part As_2O_5. A proper excess of lead oxide may be obtained by increasing the quantity mentioned to .7914, which will insure the complete precipitation of the arsenic.

Let it be required to prepare 1 pound of arsenate of lead from samples of lead nitrate (X) and sodium arsenate (Y), containing respectively 66 per cent. PbO and 40 per cent. As_2O_5: —

$$X = \frac{.7914}{.66} = 1.1990 \text{ pounds lead nitrate.}$$

$$Y = \frac{.3000}{.40} = .7500 \text{ pound arsenate of soda.}$$

Should the arsenate of soda contain 7 per cent. chlorine, as in the preceding case, the additional amount of lead nitrate (Z) required may be determined as follows: —

$$Z = \frac{.7500 \times .07 \times 3.1408}{.66} = .2498 \text{ pound lead nitrate.}$$

Adding the values of X and Z, we find that 1.4488 pounds lead nitrate and .75 pound arsenate of soda are required for the preparation of 1 pound arsenate of lead. In avoirdupois terms the relative weights stand as follows: 1 pound 2¾ ounces nitrate of lead and 12 ounces arsenate of soda.

Freshly prepared arsenate of lead consists of very finely divided particles, slightly aggregated into a flocculent, curdy white precipitate, having a specific gravity of about 1.00668, and remaining in suspension for a remarkably long time. The flocculent character of the precipitate facilitates its uniform application to the foliage, and when applied as a fine spray it soon dries to a tenacious and permanent film. In drying in mass this salt becomes compact and increases in specific gravity. Analyses of two air-dried samples of arsenate of lead, prepared respectively from the acetate and nitrate of lead, gave the following results: —

Table No. 5.

CONSTITUENTS.	Sample No. 1.	Sample No. 2.
	Per Cent.	Per Cent.
Water,	2.37	5.11
Lead oxide, PbO,	73.10	69.85
Arsenic pentoxide, As_2O_5,	21.80	24.92
Chlorine,	2.40	Trace.
Other acidulous radicals,	Trace.	Trace.
	99.67	99.88

In the preceding table sample No. 1 was prepared from "white granulated acetate of lead" and "50 per cent. arsenate of soda;" No. 2 was prepared from commercial lead nitrate and "65 per cent. arsenate of soda."

Where arsenate of lead is to be made on a large scale, after determining the relative amounts of the salts to be used it is advisable to test the formula by preparing a trial quantity, and examining the supernatant liquid for soluble lead and arsenic. For this purpose it is necessary to filter a portion of the supernatant liquid. If an excess of lead is present, by adding a few drops of potassium neutral or bi-chromate solution a beautiful chrome yellow precipitate is formed. A simple test for soluble arsenic acid may be made by adding to a portion of the filtered solution a few drops

of lead acetate solution. A white precipitate indicates the presence of soluble arsenic. From the injury to foliage produced by soluble arsenic in spraying mixtures, it is of prime importance that the liquid should show the presence of an excess of lead. When the nitrate of lead is used, the reaction may sometimes show an excess of lead before the arsenic is fully precipitated. In such cases, if the test for arsenic be made, a decided reaction will reveal its presence, and it becomes necessary to add a sufficient quantity of lead nitrate to complete the reaction.

The gypsy moth committee use annually several tons of arsenate of lead, preparing it, previous to 1897, according to the formula originally given by Mr. Moulton, "sodic arseniate, 29.93 per cent.; plumbic acetate, 70.07 per cent." (Report of the Massachusetts State Board of Agriculture, 1893, p. 282.) Careful investigations have shown that there is a difference in the chemical composition of these commercial salts that cannot be ignored, and that single arsenic and lead salts cannot be taken as types to fix the relative proportions. These salts were mixed together, weighed out in suitable quantities and placed in bags. Previous to being added to the contents of the spraying tank, this mixture was boiled in a kettle until the reaction between the salts was complete. While results obtained from arsenate of lead prepared in this manner are far superior to those obtained by the use of Paris green, several objectionable features developed, the principal one being an incomplete reaction between the mixed salts stored in bags. By this process the particles of arsenate of soda became coated with a thin crust of arsenate of lead, and when sprayed upon the foliage broke down, liberating soluble arsenic and injuring the leaves. Arsenate of lead mixture prepared by grinding together the commercial salts is also of variable composition, and gives very uneven results. Some samples contain a great excess of lead, while in others the arsenate of soda predominates. Because of the incomplete reaction previously mentioned and the uneven composition of the mixture, the arsenate of lead thus obtained often possesses mechanical properties that hinder its application to the foliage.

The best results in the preparation of arsenate of lead have

been obtained by the method adopted during the season of 1897. The amounts of lead oxide and arsenic pentoxide in the commercial salts having been determined the necessary quantities of acetate of lead and arsenate of soda were fixed. The work of weighing the salts was carried on rapidly by the aid of ballasts, on balance scales. The acetate of lead was placed in a strong paper bag which was sufficiently large to hold the smaller bag of arsenate of soda, and the whole made into a single package and tied with stout twine. A printed label giving directions for the preparation of arsenate of lead was attached to each package. When needed for spraying the salts were dissolved separately by suspending each in a small basket in a wooden* tub or keg of water. When the solutions thus obtained are poured into the spraying tank partially filled with water, arsenate of lead is thrown down as a fine white precipitate. Acetate of lead dissolves in water at about the rate of 1 pound to 1 gallon; arsenate of soda dissolves readily at the rate of 1 pound to 3 quarts of water. Both these salts dissolve easily in smaller quantities of hot water, and where the latter is available it should be used in preference to cold water. In either case great care must be taken to avoid spilling the solutions before precipitation.

It should be recognized that the arsenate of lead commonly sold in the market is a mixture and not a compound, and in reality contains but about 50 per cent. of actual arsenate of lead. In making recommendations concerning the use of this insecticide, care must be taken to indicate whether the arsenate of lead or arsenate of lead mixture is to be used. Table No. 6 gives the amounts of "white granulated acetate lead" and "65 per cent. arsenate soda" necessary to make known quantities of arsenate of lead. In this case the acetate of lead contains 60 per cent. PbO, and the arsenate of soda 45 per cent. As_2O_5 and 3 per cent. chlorine.

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* Metallic pails should never be used.

Table No. 6.

Arsenate of Lead.		Acetate of Lead Required.		Arsenate of Soda Required.		Arsenate of Lead Mixture.	
lbs.	oz.	lbs.	oz.	lbs.	oz.	lbs.	oz.
-	1	-	1¾	-	⅜	-	2
-	3	-	4	-	1 7/10	-	5 7/10
-	5	-	6¾	-	2⅞	-	9½
-	8	-	10½	-	4⅝	-	15 1/10
1	-	1	5	-	9½	1	14½
3	-	3	15	1	11¼	5	10¼
5	-	6	9	1	13⅛	8	6⅛
10	-	13	2	5	10⅚	8	12⅚

Table No. 7 gives the amounts of an average nitrate of lead and the same grade (65 per cent.) of arsenate of soda necessary to make known amounts of arsenate of lead. In this case the nitrate of lead contains 66.5 per cent. PbO and the arsenate of soda 45 per cent. As_2O_5 and 3 per cent. chlorine.

Table No. 7.

Arsenate of Lead.		Nitrate of Lead Required.		Arsenate of Soda Required.		Arsenate of Lead Mixture.	
lbs.	oz.	lbs.	oz.	lbs.	oz.	lbs.	oz.
-	1	-	1⅓	-	⅝	-	2—
-	3	-	4	-	2	-	6
-	5	-	6⅔	-	3⅜	-	10+
-	8	-	10¼	-	5½	-	15½+
1	-	1	4½	-	10¾	1	15+
3	-	3	13½	2	-	5	13½
5	-	6	6½	3	5⅓	9	11⅚
10	-	12	13	6	10⅜	19	7⅜

EXPERIMENTS WITH INSECTICIDES.

A. H. KIRKLAND, A. F BURGESS.

The dependence that necessarily must be placed upon spraying with insecticides as a means of controlling the gypsy moth in park lands and other places where more heroic measures cannot be employed has led the committee to encourage extensive investigations, under the direction of the entomologist, of insecticides both new and old, these experiments having for their object the discovery of poisons that may be used effectively against the gypsy moth, as well as the cheapening of the ones already in use. The discovery by F. C. Moulton in 1893 of the insecticidal value of arsenate of lead, and the reduction of the cost of this poison in 1897 to the extent of over one hundred dollars per ton through joint investigations by the chemist and entomologists, are among the practical results of this work.

In the course of these experiments a mass of facts has accumulated which it now seems desirable to place on record. While the field of our investigations has been a limited one, the application of the results to other insects gives the matter a wider significance. In considering the value of the insecticides here discussed in relation to insects other than the gypsy moth, the remarkable resistance to arsenical poison shown by this insect should be taken into consideration.

It will be noticed that the experiments in part cover the caterpillar seasons of two years. In such cases the work of 1897 has been a continuation, on a larger scale, of that of 1896. In the indoor experiments the larvæ were confined in suitable cages and supplied daily with freshly poisoned food. In the experiments out of doors the insects were confined in large cloth bags upon branches previously sprayed with the

insecticide. The larvæ used in the earlier experiments were obtained by the artificial incubation of the eggs.

For the sake of brevity the results of the experiments are presented in tabular form. The heading of each table states the age of the larvæ used, the poisons and amounts of each to 150 gallons of water. The figures indicate the total number of larvæ found dead on successive days. In each experiment ten larvæ were used. The check experiments afford data concerning the normal death-rate of larvæ feeding on unpoisoned food.

Paris Green v. White Arsenic.

Indoor Experiments, commenced Feb. 8, 1897. — Larvæ in First Stage.

No. of Days.	Paris Green, 1-150.	Arsenic, 1-150.	Paris Green, 2-150.	Arsenic, 2-150.	Paris Green, 3-150.	Arsenic, 3-150.	Paris Green, 5-150.	Arsenic, 5-150.	Paris Green, 8-150.	Arsenic, 8-150.	Check No. 1.
1, ...	-	-	2	-	-	2	1	1	1	5	-
2, ...	1	3	6	1	1	2	2	1	3	8	-
3, ...	2	5	7	2	3	5	4	2	10	10	-
4, ...	3	6	8	7	6	9	5	9	-	-	4
5, ...	7	8	8	7	9	9	5	9	-	-	5
6, ...	10	10	10	10	10	10	10	10	-	-	7

Duplicate Experiment, commenced March 26, 1897.

No. of Days.	Paris Green, 1-150.	Arsenic, 1-150.	Paris Green, 2-150.	Arsenic, 2-150.	Paris Green, 3-150.	Arsenic, 3-150.	Paris Green, 5-150.	Arsenic, 5-150.
1, ...	-	-	2	-	2	-	-	6
2, ...	6	6	8	7	6	2	4	9
3, ...	10	7	9	8	7	8	6	9
4, ...	-	10	10	10	9	10	6	10
5, ...	-	-	-	-	10	-	8	-
6, ...	-	-	-	-	-	-	9	-
7, ...	-	-	-	-	-	-	10	-
8, ...	-	-	-	-	-	-	-	-
9, ...	-	-	-	-	-	-	-	-
10, ...	-	-	-	-	-	-	-	-

Duplicate Experiment, etc. — Concluded.

NO. OF DAYS.	Paris Green, 8-150.	Arsenic, 8-150.	Paris Green, 10-150.	Arsenic, 10-150.	Checks. No. 1.	No. 2.	No. 3.	No. 4.
1,	4	6	4	2	2	-	-	-
2,	6	9	4	7	2	-	-	-
3,	7	9	7	10	2	-	-	-
4,	9	10	7	-	2	-	-	-
5,	9	-	8	-	2	-	-	-*
6,	9	-	9	-	2	-	-	-
7,	9	-	9	-	2	-	-	-
8,	9	-	9	-	2	-	-	-
9,	9	-	10	-	2	-	1	-
10,	10	-	-	-	2	-	1	-

* One larva lost.

Indoor Experiments, commenced April 5, 1897. — Larvæ in Second Stage.

NO. OF DAYS.	Paris Green, 1-150.	Arsenic, 1-150.	Paris Green, 2-150.	Arsenic, 2-150.	Paris Green, 3-150.	Arsenic, 3-150.	Paris Green, 5-150.	Arsenic, 5-150.
1,	4	5	5	3	-	-	6	5
2,	5	5	5	3	1	3	8	9
3,	6	7	6	5	1	4	8	10
4,	8	8	7	6	4	6	9	-
5,	8	9	8	7	5	8	10	-
6,	9	9	8	9	7	8	-	-
7,	10	9	10	10	9	9	-	-
8,	-	9	-	-	10	9	-	-
9,	-	10	-	-	-	10	-	-

Indoor Experiments, etc.—Concluded.

NO. OF DAYS.	Paris Green, 8-150.	Arsenic, 8-150.	Paris Green, 10-150.	Arsenic, 10-150.	Checks.			
					No. 1.	No. 2.	No. 3.	No. 4.
1,	4	5	5	3	-	-	-	-
2,	6	8	5	5	-	-	-	-
3,	9	9	7	8	-	-	-	-
4,	9	10	8	8	-	-	-	-
5,	9	-	9	10	-	-	-	-
6,	9	-	10	-	-	-	-	-
7,	9	-	-	-	-	-	-	-
8,	10	-	-	-	-	-	-	-
9,	-	-	-	-	-	-	-	-

Outdoor Experiments, commenced May 20, 1897.—Larvæ in Second Stage.

NO. OF DAYS.	Paris Green, 1-150.	Arsenic, 1-150	Checks.			NO. OF DAYS.	Paris Green, 1-150.	Arsenic, 1-150.	Checks.		
			No. 1.	No. 2.	No. 3.				No. 1.	No. 2.	No. 3.
1,	3	-	-	-	-	6,	9	7	8	6	7
2,	6	4	-	-	-	7,	9	9	8	6	7
3,	7	6	-	-	-	8,	9	9	9	9	9
4,	8	7	5	6	1	9,	10	9	9	9	10
5,	9	7	8	6	7	10,	-	10	9	9	-

Indoor Experiments, commenced April 15, 1897.—Larvæ in Third Stage.

NO. OF DAYS.	Paris Green, 1-150.	Arsenic, 1-150.	Paris Green, 2-150.	Arsenic, 2-150.	Paris Green, 3-150.	Arsenic, 3-150.	Paris Green, 5-150.	Arsenic, 5-150.
1, ...	-	1	1	-	6	3	3	6
2, ...	3	3	5	3	7	5	5	7
3, ...	3	4	7	6	8	8	8	10
4, ...	6	6	8	8	10	10	9	-
5, ...	6	8	9	8	-	-	10	-
6, ...	8	8	10	10	-	-	-	-
7, ...	10	8	-	-	-	-	-	-
8, ...	-	8	-	-	-	-	-	-
9, ...	-	9	-	-	-	-	-	-
10, ...	-	10	-	-	-	-	-	-

Indoor Experiments, etc.—Concluded.

NO. OF DAYS.	Paris Green, 8-150.	Arsenic, 8-150.	Paris Green, 10-150.	Arsenic, 10-150.	CHECKS.*			
					No. 1.	No. 2.	No. 3.	No. 4.
1, ...	7	5	7	5	-	-	-	-
2, ...	8	7	9	10	-	-	-	-
3, ...	10	10	10	-	-	-	-	-
4, ...	-	-	-	-	1	-	3	-
5, ...	-	-	-	-	1	-	3	1
6, ...	-	-	-	-	1	-	3	1
7, ...	-	-	-	-	1	-	4	1
8, ...	-	-	-	-	-	-	-	-
9, ...	-	-	-	-	-	-	-	-
10, ...	-	-	-	-	-	-	-	-

* Discontinued at the end of one week, as all the living larvæ had molted.

Outdoor Experiments, commenced May 28, 1897. — Larvæ in Third Stage.*

NO. OF DAYS.	Paris Green, 1-150.	Arsenic, 1-150.	Checks. No. 1.	Checks. No. 2.	Checks. No. 3.	NO. OF DAYS.	Paris Green, 1-150.	Arsenic, 1-150.	Checks. No. 1.	Checks. No. 2.	Checks. No. 3.
1, . .	-	-	-	-	-	12, . .	4	6	3	-	-
2, . .	-	1	-	-	-	13, . .	4	6	3	-	-
3, . .	-	2	1	-	-	14, . .	4	6	4	-	-
4, . .	1	2	1	-	-	15, . .	4	6	4	-	-
5, . .	2	4	1	-	-	16, . .	4	6	6	-	4
6, . .	4	5	1	-	-	17, . .	4	6	7	2	4
7, . .	4	5	1	-	-	18, . .	4	6	7	2	4
8, . .	4	5	1	-	-	19, . .	4	6	7	4	6
9, . .	4	5	1	-	-	20, . .	4	6	7	4	7
10, . .	4	6	3	-	-	21, . .	4	6	7	4	7
11, . .	4	6	3	-	-						

* Discontinued at the end of twenty-one days.

Indoor Experiments, commenced April 26, 1897. — Larvæ in Fourth Stage.

NO. OF DAYS.	Paris Green, 1-150.	Arsenic, 1-150.	Paris Green, 2-150.	Arsenic, 2-150.	Paris Green, 3-150.	Arsenic, 3-150.	Paris Green, 5-150.	Arsenic, 5-150.
1, ...	2	-	4	1	4	6	5	9
2, ...	4	2	5	2	4	9	8	9
3, ...	7	4	6	2	6	9	9	9
4, ...	7	6	7	5	7	9	9	10
5, ...	10	8	8	10	10	10	10	-
6, ...	-	10	8	-	-	-	-	-
7, ...	-	-	8	-	-	-	-	-
8, ...	-	-	9	-	-	-	-	-
9, ...	-	-	10	-	-	-	-	-

Indoor Experiments, etc. — Concluded.

NO. OF DAYS.	Paris Green, 8-150.	Arsenic, 8-150.	Paris Green, 10-150.	Arsenic, 10-150.	CHECKS. No. 1.	No. 2.	No. 3.	No. 4.
1, ...	5	7	3	3	-	-	-	-
2, ...	7	8	3	8	-	-	-	-
3, ...	8	8	4	8	-	-	-	-
4, ...	9	8	8	8	-	1	-	1
5, ...	9	9	9	9	-	1	-	1
6, ...	10	10	9	10	-	5	-	2
7, ...	-	-	9	-	-	5	-	2
8, ...	-	-	10	-	-	5	-	2
9, ...	-	-	-	-	-	5	-	2

Outdoor Experiments, commenced June 1, 1897. — *Larvæ in Fourth Stage.*

NO. OF DAYS.	Paris Green, 1-150.	Arsenic, 1-150.	CHECKS. No. 1.	No. 2.	No. 3.	NO. OF DAYS.	Paris Green, 1-150.	Arsenic, 1-150.	CHECKS. No. 1.	No. 2.	No. 3.
1, . .	1	-	-	-	-	12, . .	1	4	-	-	1
2, . .	1	-	-	-	-	13, . .	1	4	-	-	1
3, . .	1	1	-	-	-	14, . .	2	4	-	-	1
4, . .	1	1	-	-	-	15, . .	2	4	-	-	2
5, . .	1	3	-	-	-	16, . .	2	7	-	-	2
6, . .	1	3	-	-	-	17, . .	2	9	-	-	2
7, . .	1	3	-	-	-	18, . .	2	9	-	-	2
8, . .	1	3	-	-	-	19, . .	3	10	-	-	2
9, . .	1	3	-	-	-	20, . .	3	-	2	-	2
10, . .	1	4	-	-	1	21, . .	4*	-	2	4	4
11, . .	1	4	-	-	1						

* Discontinued.

Outdoor Experiments, commenced June 11, 1897. — *Larvæ in Fifth Stage.*

No. of Days.	Paris Green, 1-150.	Arsenic, 1-150.	Checks. No. 1.	Checks. No. 2.	Checks. No. 3.	No. of Days.	Paris Green, 1-150.	Arsenic, 1-150.	Checks. No. 1.	Checks. No. 2.	Checks. No. 3.
1, . .	-	-	-	-	-	12, . .	6	5	3	1	-
2, . .	-	-	-	-	-	13, . .	7	6	3	1	-
3, . .	-	1	-	-	-	14, . .	7	7	5	2	-
4, . .	-	1	-	-	-	15, . .	7	7	6	4	-
5, . .	-	1	-	-	-	16, . .	7	7	7	4	-
6, . .	-	1	-	-	-	17, . .	9	7	7	4	-
7, . .	3	1	-	-	-	18, . .	9	7	7	6	-
8, . .	3	1	2	-	9	19, . .	10	8	-*	-*	-
9, . .	3	1	2	-	10	20, . .	-	8	-	-	-
10, . .	3	2	2	-	-	21, . .	-	9*	-	-	-
11, . .	5	5	3	1	-						

* Discontinued.

Outdoor Experiments, commenced June 26, 1897. — *Larvæ in Sixth Stage.*

[Note. — Superior figures, in all cases, indicate the number of larvæ pupating on the corresponding days.]

No. of Days.	Paris Green, 1-150.	Arsenic, 1-150.	Checks. No. 1.	Checks. No. 2.	Checks. No. 3.	No. of Days.	Paris Green, 1-150.	Arsenic, 1-150.	Checks. No. 1.	Checks. No. 2.	Checks. No. 3.
1, . .	-	-	-	-	-	12, . .	4^{1}	-	-	3^{1}	3^{2}
2, . .	-	-	-	-	-	13, . .	5	-	-	4	3^{2}
3, . .	-	-	-	-	-	14, . .	5	-	-	4	3
4, . .	1	2	-	-	-	15, . .	5	-	-	4	3
5, . .	1	3	-	-	-	16, . .	6	-	1^{1}	4	3
6, . .	1	6	-	-	-	17, . .	7	-	-	4^{2}	3
7, . .	1	10	-	-	-	18, . .	7	-	-	4	4
8, . .	1	-	$-^{1}$	3	1^{1}	19, . .	7	-	-	4	-
9, . .	2	-	-	3	1	20, . .	7	-	-	4	-
10, . .	2	-	$-^{2}$	3	1^{1}	21, . .	8	-	-	4^{2}	-
11, . .	3	-	$-^{5}$	3^{1}	1						

By the direction of Professor Fernald, the preceding experiments were performed in order to determine the relative insecticidal effects of Paris green and arsenic on the gypsy moth. While arsenic seems slightly superior to Paris green so far as killing effects are concerned, its high specific gravity renders it difficult of suspension in water, and hence it cannot be applied evenly to the foliage. We have long since abandoned the use of Paris green in our spraying operations, and neither this poison nor arsenic can compete with arsenate of lead as a means for destroying the gypsy moth. The high death rate of the larvæ in the check experiments is a probable consequence of the remarkably wet season of 1897.

Scheele's Green.

Field Experiment, June 22, 1897.

Twenty square rods of badly infested oak timber and brush land were thoroughly sprayed with Scheele's green, at the rate of 5 pounds to 150 gallons of water.

July 1. About 10 per cent. of the larvæ are dead. Foliage slightly burned.
July 5. No more larvæ dead. Foliage badly burned.
July 11. Trees stripped by the larvæ, except where the foliage has been killed by the poison.

In the above experiment the object was to destroy the caterpillars, regardless of the effect upon the foliage.

LEAD ARSENITE v. LEAD ARSENATE.

Indoor Experiments, commenced June 13, 1896.—Larvæ in Fifth Stage.

NO. OF DAYS.	Lead Arsenite, 2-150.	Lead Arsenate, 2-150.	Lead Arsenite, 5-150.	Lead Arsenate, 5-150.	Lead Arsenite, 10-150.	Lead Arsenate, 10-150.
1, ...	-	-	-	-	-	-
2, ...	-	-	-	-	-	-
3, ...	-	-	-	-	-	-
4, ...	-	-	-	-	2	1
5, ...	-	-	-	-	2	3
6, ...	-	-	1	-	2	4
7, ...	-	-	2	1	2	5
8, ...	-	-	2	1	2	5
9, ...	-	2	2	3	3	9
10, ...	-	2	2	4	3	9
11, ...	-	2	2	5	3	9
12, ...	-	3	2	6	3	9
13, ...	-	4	2	8	4	9
14, ...	2	7	2	8	4	9
15, ...	2	7	2	8	4	9
16, ...	2	8	2	9	4	10
17, ...	2	8	2	10	4	-
18, ...	2	8	2	-	4	-
19, ...	2	8	2	-	4[1]	-
20, ...	2	9	2	-	4	-
21, ...	2	10	2	-	4	-
22, ...	2	-	2	-	4	-
23, ...	2*	-	2	-	4	-
24, ...	-	-	2*	-	5	-
25, ...	-	-	-	-	5	-
26, ...	-	-	-	-	7*	-

* Discontinued.

Outdoor Experiments, commenced June 19, 1896.—Larvæ in Sixth Stage.*

NO. OF DAYS.	Lead Arsenite, 2-150.	Lead Arsenate, 2-150.	Lead Arsenite, 5-150.	Lead Arsenate, 5-150.	Lead Arsenite, 10-150.	Lead Arsenate, 10-150.
1,	-	-	-	-	-	-
2,	-	-	-	-	-	-
3,	-	-	-	1	-	1
4,	-	-	-	1	-	1
5,	-	-	-	1	2	2
6,	-	-	-	1	2	2
7,	-	-	-	1	2	2
8,	-	-	-	1	2	4
9,	-	-	-	1	2	4
10,	2	-	-	1	2	6
11,	2	-	-	1	2	6
12,	3	-	-	1	2	6
13,	3	-	-[1]	2	2	6
14,	3†	-†	2	2[1]	2	7
15,	-	-	2†	2†	2	7
16,	-	-	-	-	2	7
17,	-	-	-	-	2	7
18,	-	-	-	-	2	7
19,	-	-	-	-	3	7
20,	-	-	-	-	3	8
21,	-	-	-	-	4	8
22,	-	-	-	-	4	8
23,	-	-	-	-	4	8
24,	-	-	-	-	4	8[1]
25,	-	-	-	-	4	9
26,	-	-	-	-	4	-
27,	-	-	-	-	7	-
28,	-	-	-	-	8[2]	-

* No burning of foliage appeared in these experiments. † Discontinued.

These experiments with chemically pure arsenite of lead *v.* arsenate of lead mixture (containing in reality only about 50 per cent. chemically pure arsenate of lead) show the relative superiority of the latter. The specific gravity of the arsenite of lead is much greater than that of the arsenate, and for this reason it cannot be so evenly applied to the foliage.

Barium Arsenate.*

Outdoor Experiments, commenced June 1, 1896. — Larvæ in Fourth Stage.

No. of Days.	Barium Arsenate, 1-150.	Check.	Barium Arsenate, 2-150.	Check.	Barium Arsenate, 3-150.	Check.	Barium Arsenate, 4-150.	Check.	Barium Arsenate, 5-150.	Check.	Barium Arsenate, 10-150.	Check.
1, . .	-	-	-	-	-	-	-	-	-	-	-	-
2, . .	-	-	-	-	-	-	-	-	-	-	-	-
3, . .	1	-	-	-	1	-	1	-	1	-	-	-
4, . .	1	-	-	-	1	-	1	-	1	-	-	-
5, . .	2	-	-	-	6	-	3	-	2	-	5	-
6, . .	2	-	-	-	6	-	3	-	2	-	5	-
7, . .	2	-	-	-	6	-	3	-	2	-	5	-
8, . .	2	-	-	-	6	-	3	-	2	-	5	-
9, . .	2	-	-	-	6	-	3	-	2	-	5	-
10, . .	2	-	-	-	6	-	3	-	2	-	5	-
11, . .	3	1	2	-	8	-	5	-	5	-	7	-
12, . .	3	1	2	1	8	-	5	-	5	-	7	-
13, . .	3	1	2	1	8	-	5	-	5	-	10	-
14, . .	3	1	2	1	8	-	5	-	5	-	-	-
15, . .	3	1	2	1	8	-	5	-	5	-	-	-
16, . .	3	1	5	1	8	-	5	-	5	-	-	-
17, . .	3†	1†	5†	1†	10	-†	10	-†	10	-†	-	-†
18, . .	-	-	-	-	-	-	-	-	-	-	-	-

* Foliage uninjured. † Discontinued.

Outdoor Experiments.—Larvæ in Sixth Stage.

NO OF DAYS.	June 22, 1896.			June 25, 1896.
	Barium Arsenate, 12-150.*	Barium Arsenate, 15-150.*	Barium Arsenate, 20-150 †	Barium Arsenate, 40-150.†
1,	-	-	-	-
2,	-	-	1	6
3,	-	-	1	6
4,	-	1	4	10
5,	1	6	7	-
6,	1	6	7	-
7,	2	10	10	-
8,	2	-	-	-
9,	2	-	-	-
10,	2	-	-	-
11,	6	-	-	-
12,	6	-	-	-
13,	6	-	-	-
14,	6	-	-	-
15,	8	-	-	-
16,	10	-	-	-

* Foliage slightly burned. † Foliage badly burned.

Barium Arsenate.

Field Experiments.

Ten pounds to 150 gallons; glucose, 1 gallon to 150; 50 square rods red oak and white oak brush; larvæ in second and third stages. Echo Street, Malden.

Sprayed May 24, 1897:—
May 26. No results.
May 28. No results.
May 29. No results.
June 3. Few larvæ dead; foliage burned Discontinued.

Ten pounds to 150 gallons; glucose, 1 gallon to 150; 30 square rods white oak and red oak brush; larvæ in second and third stages. Valley Street. Medford.

Sprayed May 24, 1897: —

May 26. No results.

May 28. No results.

May 29. No results.

June 3. Few larvæ dead; foliage burned; tender foliage badly burned. Discontinued.

The barium arsenate used in the two preceding experiments had stood in the "mother liquor" all winter, and had developed a considerable amount of soluble arsenic. In the following experiment the barium arsenate was freshly prepared: —

Ten pounds to 150 gallons; glucose, 1 gallon to 150; 100 square rods oak, pine and white birch brush; larvæ in fourth and fifth stages. Hawkes' Farm, Saugus.

Sprayed June 18–19, 1897: —

June 24. Many larvæ dead. Special Inspector Little agrees with me in estimating that 60 per cent. of the larvæ have been killed. Not as many dead as where arsenate of lead, 20-150, is used. No burning apparent; poison does not show well on foliage.

June 29. Sprayed area in about the same condition as on June 24; more larvæ have died, but there are many large ones still feeding; bushes are being stripped; poison disappeared; no burning of note.

July 3. Poison has stopped killing; slight burning on tender foliage; effect not as good as where arsenate of lead, 20-150, is used. The greatest fault seems to be in the ease with which the poison is washed from the foliage Larvæ pupating. Discontinued.

The experiments with barium arsenate in 1896 gave so good results that we were hopeful that this insecticide would prove superior to lead arsenate. Its killing effects on larvæ in confinement are certainly superior to those of arsenate of lead. In the field spraying operations it was found that the poison did not adhere to the foliage for a sufficiently long time to kill the larvæ. With the lessening of the cost of arsenate of lead we have now effected, barium arsenate cannot compete with it.

LEAD PHENOLATE.*

Outdoor Experiments, commenced July 1, 1897.—Larvæ in Fifth Stage.

NO. OF DAYS.	Lead Phenolate, 1-150.	Lead Phenolate, 2-150.	Lead Phenolate, 3-150.	Lead Phenolate, 5-150.	Lead Phenolate, 8-150.	Lead Phenolate, 10-150.
1, . . .	-	-	-	-	-	-
2, . . .	-	-	-	-	-	-
3, . . .	-	-	-	-	-	-
4, . . .	-[1]	-	-	-	-	-[1]
5, . . .	1[1]	1	-	-	-	-
6, . . .	1	5	-	-	-[1]	-[2]
7, . . .	1[1]	5	-	-	-	-
8, . . .	2	5[1]	1[1]	-[3]	1[1]	-
9, . . .	2	6	1	-	1	-
10, . . .	2	6	2[1]	-	3	-
11, . . .	2	6	2	-	3	-
12, . . .	2	7	3[2]	1[1]	4	-
13, . . .	2	9	3[3]	3	5	-
14, . . .	2	-	-	3	5[1]	1[2]
15, . . .	3	-	-	4	5	1
16, . . .	5	-	-	5	5	1
17, . . .	5[1]	-	-	5	5	2
18, . . .	6	-	-	5	5	2
19, . . .	-	-	-	5	5	2[2]
20, . . .	-	-	-	5	5	2
21, . . .	-	-	-	5	5	2[1]

* Foliage uninjured.

Outdoor Experiments, commenced July 1, 1897. — Larvæ in Sixth Stage.

NO. OF DAYS.	Lead Phenolate, 1-150.	Lead Phenolate, 2-150.	Lead Phenolate, 3-150.	Lead Phenolate, 5-150.	Lead Phenolate, 8-150.	Lead Phenolate, 10-150.
1, . . .	-	-	-	-	-	-
2, . . .	-	-	-	-	-	-
3, . . .	1	$-^{1}$	-	-	-	-
4, . . .	1	-	-	-	$-^{1}$	-
5, . . .	1^{2}	$-^{2}$	$-^{1}$	$-^{2}$	$-^{1}$	-
6, . . .	1	-	$-^{1}$	2^{2}	-	-
7, . . .	2	$-^{2}$	-	2	$-^{1}$	$-^{1}$
8, . . .	2^{1}	-	$-^{2}$	3^{2}	-	1
9, . . .	3	$-^{1}$	1	4	$-^{1}$	1
10, . . .	3	$-^{3}$	1^{3}	-	-	1
11, . . .	3	-	1	-	1	1^{3}
12, . . .	4^{3}	-	1^{2}	-	1^{1}	1^{4}
13, . . .	-	-	-	-	1^{1}	1
14, . . .	-	-	-	-	1^{1}	1
15, . . .	-	$-^{1}$	-	-	1^{2}	1
16, . . .	-	-	-	-	-	1^{1}
17, . . .	-	-	-	-	-	1
18, . . .	-	-	-	-	-	1
19, . . .	-	-	-	-	-	2
20, . . .	-	1	-	-	-	-
21, . . .	-	-	-	-	-	-

Phenolate of Lead.

Field Experiment.

Grayish white salt of low specific gravity; mixes with difficulty in water; particles coarse; 10 pounds to 150 gallons; glucose, 6 quarts to 150 gallons; large apple tree badly infested; larvæ in fifth and sixth stages. Fenwick Street, Malden.

Sprayed July 1, 1897: —
July 3. No larvæ dead.
July 10. No larvæ dead. No burning.
July 19. No larvæ dead. Greater part of larvæ pupating.
July 21. No larvæ dead. No burning. Discontinued.

It would seem as though so powerful an organic poison as phenol would have had more effect upon the larvæ.

DI-PLUMBIC ARSENATE v. TRI-PLUMBIC ARSENATE.

Outdoor Experiments, commenced July 9, 1897.—Larvæ in Fifth Stage.

NO. OF DAYS.	Di-Plumbic Arsenate, 5-150.	Tri-Plumbic Arsenate, 5-150.	Di-Plumbic Arsenate, 10-150.	Tri-Plumbic Arsenate, 10-150.	Di-Plumbic Arsenate, 15-150.	Tri-Plumbic Arsenate, 15-150.	Di-Plumbic Arsenate, 20-150.	Tri-Plumbic Arsenate, 20-150.
1, ...	-	-	-	-	-	-	-	-
2, ...	-	-	-	-	-	-	-	-
3, ...	1	-	-	-	-	-	-	-
4, ...	2	$-^{2}$	-	1^{1}	$-^{1}$	1	-	3^{1}
5, ...	4^{2}	-	2^{1}	1	-	1	1^{1}	4^{1}
6, ...	4	2^{1}	2	1^{1}	1	3^{2}	5	4^{1}
7, ...	4^{1}	2	2	1	1	3^{1}	6	4
8, ...	4	2	3^{1}	1	2	4	7	5
9, ...	4^{1}	3	4	2	2	4	7	5
10, ...	4	4^{1}	4	4	3^{1}	4^{1}	7	5
11, ...	4	4	5	4	-	5	8	5
12, ...	4	4	6	4	-	5	8	5
13, ...	4	4	6	4	-	5	8	5
14, ...	5	4	6	4	-	5	8	6
15, ...	5	5	6^{1}	5	-	5	8	6
16, ...	6	5	6	5	-	6	8	6
17, ...	-	5	6^{1}	6	-	-	9	6
18, ...	-	5	-	6	-	-	-	6
19, ...	-	5	-	6	-	-	-	6
20, ...	-	5	-	6	-	-	-	6
21, ...	-	5*	-	6*	-	-	-	6*

* Discontinued.

Outdoor Experiments, commenced July 9, 1897.—Larvæ in Sixth Stage.*

NO. OF DAYS.	Di-Plumbic Arsenate, 5-150.	Tri-Plumbic Arsenate, 5-150.	Di-Plumbic Arsenate, 10-150.	Tri-Plumbic Arsenate, 10-150.	* Di-Plumbic Arsenate, 15-150.	Tri-Plumbic Arsenate, 15-150.
1, ...	-	-	-	-	-	-
2, ...	-	-	-	-	-	-
3, ...	-	-	-	-	-	-
4, ...	-	1^{5}	-	$-^{2}$	1	2
5, ...	$-^{2}$	1^{1}	$-^{1}$	1^{1}	1	2
6, ...	-	1	-	1	4^{1}	3^{1}
7, ...	3	1	-	1^{2}	4	3
8, ...	5^{1}	1	1	1	4^{2}†	3
9, ...	5	1^{1}	2	2	4	3^{1}
10, ...	5	1^{1}	2	2	4^{1}	3^{1}
11, ...	7	1	4^{1}	2	5	3
12, ...	-	1	5	2^{1}	-	4
13, ...	-	1	5	2	-	4
14, ...	-	2	6	2	-	5^{2}
15, ...	-	-	6	2^{1}	-	-
16, ...	-	-	7^{1}	2	-	-
17, ...	-	-	-	2^{1}	-	-
18, ...	-	-	-	-	-	-
19, ...	-	-	-	-	-	-
20, ...	-	-	-	-	-	-
21, ...	-	-	-	-	-	-

* Foliage uninjured. † One larva lost.

Outdoor Experiments, etc.* — Concluded.

NO. OF DAYS.	Di-Plumbic Arsenate, 20-150.	Tri-Plumbic Arsenate, 20-150.	CHECKS. No. 1.	CHECKS. No. 2.	CHECKS. No. 3.
1,	-	-	-	-	-
2,	-	-	-	-	-
3,	-[1]	-	-	-	-
4,	-	-[3]	-	-	-
5,	1[1]	3[4]	-	-	-
6,	1	-	-	-	-
7,	1	-	-	-	-
8,	1	-	-[1]	3	1[1]
9,	1	-	-	3	1
10,	2[1]	-	-[2]	3	1[1]
11,	5	-	-[5]	3[1]	1
12,	5	-	-	3[2]	3[2]
13,	5	-	-	4	3[2]
14,	5	-	-	4	3
15,	5	-	-	4	3
16,	5	-	1[1]	4	3
17,	6[1]	-	-	4[2]	3
18,	-	-	-	4	4
19,	-	-	-	4	-
20,	-	-	-	4	-
21,	-	-	-	4[1]	-

* Foliage uninjured.

Di-Plumbic Arsenate.

Field Experiments.

Twenty pounds to 150 gallons; glucose, 1 gallon to 150; red oak and white oak brush; badly infested; larvæ in fifth and sixth stages. Pierce Street, Malden.

Sprayed June 25, 1897
June 29. Killing well.
July 1. Killing well. Stripping of foliage has stopped.
July 3. Killing well. Eighty per cent. of the larvæ are dead
July 10. Killing well. Many larvæ pupating.
July 15. Poison nearly through killing, because of pupation of larvæ. Has given excellent results; no burning of foliage.
July 21. Few dead larvæ; no burning. Poison has killed as well or a little better than the tri-plumbic arsenate.

Twenty pounds to 150 gallons; glucose, 1 gallon to 150; red oak and white oak trees of medium size, badly infested by larvæ in fifth and sixth stages. Pine Hill Path, Metropolitan Park Reservation, Medford.

Sprayed June 26, 1897: —
June 29. Killing well. Dead larvæ plenty in path.
July 1. Killing well. Dead larvæ plenty in path.
July 5. Killing well.
July 10. Killing well. Sixty per cent. of the larvæ dead.
July 21. Poison still killing, although the greater part of the larvæ have transformed. No burning of foliage. The results from the experiment are equally as good as those where the tri-plumbic arsenate is used.

Tri-Plumbic Arsenate.

Field Experiment.

Check experiment on the preceding; 20 pounds to 150 gallons; opposite side of path.

Sprayed June 26, 1897: —
June 29. Killing well.
July 1. Killing well. Plenty of dead larvæ.
July 5. Killing well. Plenty of dead larvæ.
July 10. Still killing; no burning; about sixty per cent. of the larvæ dead.
July 21. Few dead larvæ; greater part pupated.

The di-plumbic arsenate was prepared from nitrate of lead. So far, this insecticide seems equal if not superior to the tri-plumbic arsenate. Extensive field experiments will be made with the di-plumbic arsenate during the season of 1898, should the Legislature provide means for the continuation of this work.

The "di-plumbic arsenate" is composed of about two-thirds di-plumbic arsenate and one-third tri-plumbic arsenate. The tri-plumbic arsenate is approximately pure.

DANGER FROM THE USE OF ARSENATE OF LEAD.

A. H. KIRKLAND, M.S.

A matter of considerable importance in extensive spraying operations with arsenic compounds is the frequent complaint of arsenical poisoning on the part of those who apply the poison to the foliage. In our work against the gypsy moth such complaints are not uncommon, and, since our employees apply from two to three tons of this insecticide to infested trees and shrubbery in a spraying season of from four to six weeks, it has sometimes appeared that these complaints might rest on a basis of fact. Cases of supposed arsenical poisoning are of more frequent occurrence toward the close of the spraying season; and to get at the actual physical condition of our men at such a time, a series of investigations was attempted late in June, 1897.

It is conceded by physicians and toxicologists that when arsenic is taken into the system, either *via* the mouth, lungs or skin, it is chiefly eliminated by means of the kidneys, and that the presence of arsenic in the urine of a sick man is fairly conclusive evidence of arsenical poisoning. An effort was made, but with only partial success, to collect twenty-five samples of urine from men who for some time had been engaged in spraying. Two rather interesting discoveries were made at this time: first, the almost complete indifference on the part of the men in normal health in regard to the whole matter; and second, the enumeration by those who were temporarily out of health of many alarming symptoms which were ascribed to the effects of the poison. Only eight samples were obtained, and these were sent to Mr. F. J. Smith for analysis, with the following results: —

No. 1. — Taken 6 A.M., June 27. Man in good health; had been engaged in spraying about two weeks; trace of arsenic found.

No. 2. — Taken 8.15 A.M., June 24. Man enjoyed good health up to the spraying season; had been engaged in spraying three weeks and during the last week had suffered from loss of appetite, with considerable disturbance of the digestive system; 17.6 mg. arsenic per litre were found.

No. 3. — Taken 12 noon, June 24. Man in fair health, aside from an occasional "bilious attack;" had sprayed for three weeks; no arsenic found.

No. 4. — Taken 12.30 P.M., June 24. Man in good health, but appetite poor at times; had worked at spraying for three weeks; no arsenic found.

No 5. — Taken 1.30 P.M., June 24. Man in excellent health; had sprayed for six days; trace of arsenic found.

No 6. — Taken June 26. Man in poor health; was well until after he had worked at spraying about two weeks; had sprayed nearly four weeks; trace of arsenic found.

No. 7. — Taken June 26. Man had complained of various derangements of his digestive system; had sprayed for "over three weeks;" .2 mg. of arsenic per litre found.

No. 8. — Taken June 1. Man in poor health; had been engaged in experimenting with Paris green and other arsenical compounds for about three months; 4 mg. arsenic per litre found.

The results of these analyses show conclusively that in some cases men engaged in spraying acquire dangerous amounts of arsenic. That actual sickness resulting from this work is rare, is shown by the fact that but few of our many employees lose time from this cause. A case of this kind investigated by the writer in 1896 proved to be one of unmistakable arsenical poisoning, which in this instance was not strange, since less than one week previous to the time the man was taken sick he was observed to be especially careless in the use of the poison, allowing the drippings of the spraying pole to run freely up his arms and probably over the greater part of his body. Nowhere, perhaps, do we find a better illustration of the contempt bred by familiarity than in the manner in which men engaged in spraying make use of insecticides. In the case of our employees an excuse is found in the high state of physical vigor that characterizes the whole force, — the natural result of an active, outdoor life.

Strangely enough, the most frequent cause for complaint

in the use of arsenate of lead is an entirely harmless one. The *odor* of the spray when very pronounced often causes considerable anxiety among those engaged in spraying, and in one or two cases has been known to produce nausea. This odor is not produced by the arsenic or the lead, but is the rich creosote smell remaining in the crude acetic acid used in the manufacture of acetate of lead. This acid is one of the resultants of the destructive distillation of wood, and retains the smoky odor even after passing through several chemical reactions.

It may be stated, in general terms, that while an occasional person may become poisoned during extensive spraying operations with arsenate of lead, premonitory symptoms appear in ample time for a change of work to be arranged; and since the conditions existing in the work against the gypsy moth are exceptional, the farmer or fruit grower may use this insecticide with less fear of danger from poisoning than is the case where Paris green or London purple is used. In all cases proper care must be taken in handling the poison and in preventing the exposure of the skin to the spray.

The danger to animals from feeding on grass under trees that have been sprayed is a matter that has at times received a large measure of popular attention in the region infested by the gypsy moth, and at the time of spraying we have always taken the precaution to advise all property owners of the possible danger to their fowls and live stock. The experiment detailed below is of interest in this connection.

On June 26, 1896, sufficient grass to make two large feedings for a horse was cut and spread beneath a pear tree of medium size, and the tree heavily sprayed with arsenate of lead, at the rate of 20 pounds to 150 gallons of water. The drippings from the tree were not sufficient to discolor the grass to any marked degree, so the nozzle was turned on to the grass, and the latter thoroughly drenched. By a previous arrangement with Müller Brothers, tannery proprietors, North Cambridge, a horse had been secured for experimental purposes. This horse weighed about 1,200 or 1,300 pounds, was perfectly sound except for a badly sprained leg, and because of this latter defect was soon to be slaughtered. The grass treated as described was taken to

the tannery and fed to the horse during the afternoon and evening of June 26. On June 28 the writer found the horse well and hearty, and in "*better condition,*" so the teamsters at the tannery stated, than before the grass had been fed to him. The poison used in spraying was mixed with cold water, and in a few days it was found that the foliage of the pear tree was badly burned, thus proving the presence of soluble arsenic in the mixture, and showing that it was even more dangerous to animal life than properly prepared arsenate of lead would have been.

DIGESTION IN THE LARVÆ OF THE GYPSY MOTH.

A. H. KIRKLAND, F. J. SMITH.

The remarkable resistance exhibited by the larvæ of the gypsy moth toward internal poisoning has afforded a basis for the suggestion, so frequently made, that the digestive functions in this insect may differ either in character or in degree from that of insects more readily killed by arsenical poisons. To gain a better idea of the nature of the digestive process in the gypsy moth larva, a limited series of investigations was made in the summer of 1896 by the writers, Mr. Kirkland attending to the anatomical and physiological phases of the question, and Mr. Smith conducting the chemical analyses. It was hoped at the time these investigations were discontinued that further study of the subject could be made during the summer of 1897, but this has been prevented by the demands of other work. Although but a few points are established by our studies, it now seems advisable to publish them as a contribution to the knowledge of digestion in insects. We may properly state here our belief in the importance of a thorough understanding of this subject, and that whenever it is reached many obscure points in the behavior of different insects toward internal poisons will be cleared up.

That the processes taking place in the alimentary canal of the gypsy moth larva may be better understood, it may be well to briefly consider the composition of the food consumed and the anatomy of the digestive tract.

The Food of the Gypsy Moth.

In common with other Bombycid caterpillars, the larvæ of the gypsy moth are practically confined for food to leaves of trees, shrubs or plants; in certain rare cases this insect

has been known to devour bark, buds, blossoms and fruit, but, as these are exceptions, they may be properly excluded from consideration.

Leaves may be said to consist of a large amount of organic matter associated with water, and a small quantity of mineral matter. In the ash are found certain elements, such as potash, lime, phosphorus, etc., which play an important rôle in plant economy; but the substances serving as food in leaves are organic, and consist mainly of proteids, carbohydrates and fat. These compounds are present in the protoplasm with which the cells are filled, and, when consumed and assimilated by the insect, serve as muscle builders, sources of fat, energy and heat, repair wasted tissues and bring about the normal growth of the insect. Undoubtedly the proteids are the most important food elements, and probably serve as the source of the chitin of which the body integument is formed. The lignin, cellulose and similar substances found in leaves are of but little value as food.

The Digestive System.

The internal anatomy of the larva, pupa and imago has been fully detailed in another place,* hence it will suffice to state that the digestive system of the larva consists of a pair of stout jaws, a buccal cavity, a pharynx dilating into an anterior stomach in the forward body segments, a stomach proper, extending through a greater part of the body cavity, an intestine and a short dilated rectum. Discharging into the mouth are a pair of salivary glands, while six malpighian vessels are attached to the rectum.

The Digestive Processes.

The jaws of the larva serve to incise and comminute the food which passes directly from the mouth into the anterior stomach, where it is subjected to the action of an alkaline fluid. It is of interest to note that in this stomach, sometimes greatly distended with food, there is always a large

* Kirkland, article on "Internal Anatomy;" "The Gypsy Moth," Forbush-Fernald, 1896.

amount of fluid present. From the anterior stomach the food passes backward into the posterior stomach (the stomach proper), an organ well supplied with strong annular muscle fibres. In this organ the disintegration and digestion of the food become more marked. By the action of the stomach muscles the food is gradually forced along until it reaches the narrow intestine, through which it passes to the rectum, from which the refuse material is voided from time to time.

Microscopic examinations of the contents of different parts of the alimentary canal show that the greater part of the food retains much of its original physical character. The fibrous elements pass through the system practically unchanged. The softer tissues undergo a partial disintegration, but in general the cellular structure can be recognized. In the contents of the cells, however, there is a great change; in food removed from the anterior stomach the cell contents showed only a partial destruction, while in samples from near the intestine the protoplasm had nearly disappeared, only the chlorophyll granules remaining. From these examinations it appears that the process of digestion in this larva is practically one of solution or extraction: the digestive fluids dissolve the soluble proteids, carbohydrates, fats, salts, etc., while the insoluble parts are eventually ejected. The stomach muscles do not perform the function of grinding, otherwise the physical characters of the food would be destroyed before it reached the intestine. Doubtless the function of these muscles is to force the stomach contents posteriorly, and by this movement bring the food more thoroughly in contact with the digestive fluids; the same is probably true of the weaker muscles of the anterior stomach, although these muscles are equally capable of reverse peristalsis, as shown by the ejection of a part of the contents of this organ from the mouth of the larva whenever the insect is roughly handled.

According to Plateau, the products of digestion in herbivorous insects consist of salts in solution, peptones, sugar and emulsified fats. These substances pass by osmosis through the walls of the alimentary canal and mingle with the blood.

The Alkalinity of the Alimentary Canal.

At the time the article on the anatomy of the gypsy moth was prepared it was noticed that the digestive fluids of the larva were strongly alkaline; but, while the fact seemed quite suggestive, investigations of the cause of this alkalinity were deferred until such a time as the assistance of a chemist could be obtained.

For a preliminary examination several full-grown caterpillars were killed by exposure to fumes of chloroform, and the alimentary canal of each carefully removed and washed. After maceration in water the material was subjected to a careful analysis for both organic and inorganic bases and acids, but nothing of an organic nature that could give an alkaline reaction to the digestive fluids could be detected. Repeated examinations of the water extract, however, showed the presence of appreciable amounts of phosphoric acid and potassium, with traces of calcium and magnesium. It is well known that the phosphates of potassium and sodium give an alkaline reaction with litmus, and, since the presence in the digestive fluid of comparatively large quantities of potassium and phosphoric acid was proven, it was apparent that the alkalinity of this fluid is due to the presence of a phosphate of potash.

Having thus determined qualitatively the source of the alkalinity, it seemed desirable to make a quantitative analysis of the digestive systems of a number of larvæ, in order to obtain an accurate idea of the amount of phosphates of potash occurring in each insect. For this purpose the following method was adopted: the alimentary canals of sixty-six larvæ were carefully removed, washed and macerated in water, as in the previous analysis, and, it having been found that the albuminous substances contained in the material seriously interfered with filtration, resort was made to dialysis, with good results. The macerated material was placed in a dialyzing apparatus and suspended in a dish containing a large quantity of freshly distilled water, the whole being kept at a cool temperature, and the water in the dish replaced with a fresh supply at intervals of twelve hours each for seventy-two hours. At the end of this time the water taken

from the dish was evaporated to a convenient volume upon a water bath, when aliquot parts of the liquid were taken for the determination of phosphoric acid and potash. The phosphoric acid was determined by the ammonium molybdate method and the amount of potash estimated as the double chloride of platinum, following as closely as possible the methods of fertilizer analyses adopted in 1895 by the Association of Official Agricultural Chemists. Briefly stated, the results of these analyses were as follows: —

	Grams.		Milligrams.
Phosphoric acid found in 66 larvæ, .	.036998,	per larva,	.560
Potash (K_2O) found in 66 larvæ, .	.073750,	per larva,	1.117
The phosphoric acid as above stated, in the form of tri-potassic phosphate, requires of potash, . . .	.073450		
Error, ...	.000300		

This shows conclusively that the phosphoric acid and potash in the alimentary canal of this insect exist in the form of tri-potassic phosphate, K_3PO_4.

Studies on Other Lepidoptera.

To learn how commonly phosphate of potash occurs in the alimentary canal of Lepidoptera, a number of larvæ were dissected and the parts removed for analysis. The following table presents the results of the analyses. Unless otherwise stated, the data pertain to the alimentary canal of the larva of the species mentioned.

		Amount of Potash.	Amount of Phosphoric Acid.
	Sphingidæ.		
1.	*Thyreus abbotii*, ...	Fair,	Fair.
2.	*Thyreus abbotii* (excrement), . . .	Small,	Trace.
3.	*Deilephila chamænerii* Harr., . . .	Fair,	Fair.
4.	*Philampelus achemon* Dru., ...	Fair,	Large.
5.	*Protoparce celeus* Hbn., ...	Fair,	Large.
6.	*Protoparce celeus* (second specimen), . .	Large,	Fair.
7.	*Sphinx drupiferarum* S. and A., . . .	Fair,	Fair.
8.	*Sphinx gordius* Cram., ...	Fair,	Fair.
9.	*Sphinx gordius* (excrement), . . .	Small,	Trace.
10.	*Dolba hylæus* Dru., ...	Small,	Fair.
11.	*Cressonia juglandis* S. and A., . . .	Fair,	Fair.
	Arctiidæ.		
12.	*Pyrrharctia isabella* S. and A., ...	Fair,	Large.
13.	*Spilosoma virginica* Fabr., ...	Fair,	Fair.
14.	*Hyphantria cunea* Dru., ...	Fair,	Large.
15.	*Halesidota caryæ* Harr., ...	No test made,	Small.
	Liparidæ.		
16.	*Orgyia leucostigma* S and A., . . .	Fair,	Fair.
17.	*Porthetria dispar* L. (rectum), . . .	Fair,	Small.
18.	*Porthetria dispar* (excrement of female), .	Fair,	Large.
19.	*Porthetria dispar* (fertile nest), . . .	Fair,	Large.
20.	*Porthetria dispar* (fertile nest), . . .	Large,	Large.
21.	*Porthetria dispar* (infertile nest), . .	Large,	Large.
	Notodontidæ.		
22.	*Datana ministra* Dru., ...	Small,	Small.
23.	*Datana ministra* (newly hatched larvæ, whole insect), ...	Trace,	Trace.
24.	*Datana integerrima* G. and R., . . .	Large,	Large.
	Saturniidæ.		
25.	*Attacus cecropia* L. (eggs), ...	Large,	Large.
26.	*Hyperchiria io* Fabr., ...	Fair,	Fair.
	Ceratocampidæ.		
27.	*Anisota senatoria* S. and A., ...	Fair,	Fair.

The results of these analyses show that phosphate of potash, although varying in amount, is a constant ingredient of the digestive fluids of leaf-eating Lepidoptera, and this fact gives additional evidence of the importance of the substance. We would call particular attention to the fact that but little of this compound was found in the excrement examined (Nos. 2, 9). This shows that the phosphate of potash is retained in the system, since the analyses of the alimentary canals of the corresponding insects (Nos. 1, 8) revealed a fair amount of the substance.

The Function of Phosphate of Potash in Lepidoptera.

In the larvæ examined, phosphate of potash was always found associated with albuminoids. This coincidence, which is also common in plants, seems to show that in living organisms there is an intimate relationship between these substances. Schumacher states that if alkaline phosphates "are mixed with a solution of albumen, or if a solution of them is permitted to diffuse against one of albumen, a much greater amount of the latter will pass through the membrane than would otherwise be the case." *

In the fluid obtained as a result of the dialysis of the digestive systems of *dispar* larvæ a small amount of albumen was found associated with the phosphate of potash. This albumen would not coagulate upon the application of heat, but was precipitated by the addition of alcohol.

From the physiological stand-point the natural inference is that the phosphate of potash aids in the assimilation of albuminoids. The facts in the case may be briefly stated as follows: —

Albuminous substances form an important part of the insect's food. The process of assimilation in *dispar* is one of osmosis. Albuminous substances do not readily pass through the stomach walls, but phosphate of potash aids them in their diffusion. Since this compound is present in such large quantities, it seems evident that its function is, as stated, to aid in the osmosis of albuminoids through the walls of the alimentary canal into the blood.

* "Physik der Pflanze," 1867, p. 129.

We incline to the belief that this compound plays a most important rôle in the economy of the insect, in connection with the digestive process and also in the changes taking place in the pupal state. It seems probable that the phosphate of potash bears a somewhat intimate relation to the development of the reproductive system, since eggs of both fertilized and unfertilized female moths contain large quantities of this compound (Nos. 19, 20, 21). It also occurs in the thick fluid ejected by newly emerged imagoes (No. 18).

Relation to Insecticides.

In connection with the discovery of the source of the alkalinity of the digestive fluids of gypsy moth larvæ, two lines of insecticide experiments suggest themselves: —

1. To introduce into the digestive system of the larva some substance that shall be inert in neutral or weak acid media, and which shall react with phosphate of potash, liberating an effective poison.

2. To obtain a substance that, when taken into the digestive system of the insect, shall precipitate the phosphoric acid, thus destroying its function and preventing the assimilation of albuminous food materials.

NOTES ON PREDACEOUS BEETLES, 1897.

A. F. BURGESS, M.S.

During the season of 1897, predaceous beetles, especially those belonging to the genus *Calosoma*, have been abundant in many localities infested by the gypsy moth, in marked contrast to the condition last year, when considerable difficulty was experienced in obtaining sufficient examples of *Calosoma frigidum* Kirby for making studies on its life history. During the past summer the study of this group of beneficial insects has been continued, several new facts concerning their habits ascertained, and the statements made by the writer in the last annual report of the committee have received additional verification.

The climbing habits of the genus have been noticed this year more than ever before, and the killing of caterpillars by these beetles, even in the tallest trees, has been repeatedly witnessed. In a colony of the gypsy moth in Saugus, June 25, 1897, *C. frigidum* was observed to climb nearly to the top of a small oak tree and feed upon the caterpillars. When in the top of the trees or at the ends of the limbs, if the tree is suddenly shaken by the wind the beetles often drop to the ground, and in a piece of woodland where they are abundant they are often heard striking upon the leaves, having fallen or dropped from the trees.

Mr. W. W. Stevens, an inspector who worked in the Saugus colonies, where beetles of this genus were common, informs me that on two occasions he has seen specimens of *C. frigidum* fly, or rather "scale," to the ground from a tree after the manner of a flying squirrel. I have occasionally noticed that the beetles vibrate their wings in confinement, but have flung them into the air repeatedly without seeing them make the slightest effort to fly. Mr. Stevens is of

the opinion, however, that they would not fly upward, but simply extend their wings to lessen the velocity of the fall.

Calosoma scrutator (Fab.) has been found to be fully as active, particularly as regards climbing, as *frigidum*, and, on account of its greater size and strength, is a more formidable enemy to caterpillar life. The amount of good done does not depend entirely on the number of larvæ which the beetles actually eat, as when food is plenty they kill or mutilate a great many which they make no pretence of eating, as is shown by the following statement. Mr. Harry Vinton, while working in a colony of the gypsy moth in Saugus, during June, 1897, saw a *C. frigidum* kill or wound seven of the caterpillars on a tree trunk and then disappear among the brush. All the larvæ were so badly disabled that they could not recover.

The representatives of this genus are found principally in the spring and early summer, and after laying their eggs probably remain in the ground. This has been found to be the case with the beetles kept in confinement in cages. After midsummer the food supply is usually less plentiful, and these beetles probably do not feed on vegetable matter during the latter part of the season, as do some other Carabids. *Harpalus caliginosus* (Fab.), for example, was taken September 23, feeding on the flower-heads of the ragweed (*Ambrosia artemisiæfolia*), one of our most common garden weeds.* Professor Forbes, in his study of the food of Carabidæ, found, from dissecting three *C. scrutator* and nine *C. calidum*, that only food of animal origin was present in the stomachs. He also emphasizes the fact that the mouth parts of this genus are adapted for animal rather than vegetable feeding.†

The Calosomas, aside from being able to hibernate as imagoes, can also live an almost incredible length of time without taking food. The following notes may be of interest in this connection. A single female of *Calosoma willcoxi* Lec., kept in confinement, ate nothing from June 30 to August 18; several specimens of *C. frigidum*, confined in a breeding

* This observation corroborates those of Wm. Trelease ("American Entomologist," 1880, p. 251) and Wm. A. Buckhout (*ibid.*, p. 277).

† Bulletin Illinois State Laboratory of Natural History, Nos. 3 and 6, 1883.

cage, received no food from July 21 to September 1; and specimens of *C. scrutator* have been kept two weeks without food. In all these cases the beetles survived, and seemed to suffer no serious inconvenience. They were, however, a little more sluggish in movement, and remained in the ground more than was the case earlier in the season, when food was plentiful. One of the principal reasons for allowing the beetles to be without food was the scarcity of caterpillars after midsummer. Substitutes for larvæ, such as snails, beef, veal, kidney and grasshoppers, were tried, with very poor results. When snails were used as food for the beetle larvæ, their legs soon became covered with slime, and death followed.

Calosoma frigidum Kirby.

Sept. 24, 1896, two males and three females of this species were placed in a wire cage near the insectary. The cage consisted simply of a cylinder of wire mosquito netting sunk nearly to the level of the ground, the top being covered with a cloth which was held in place by an elastic band. The records of these three females are given here in full. They were captured June 4, 19 and 26, 1896, and each of the first two were immediately placed in separate jars with a male beetle. The first laid seventeen eggs June 5, but deposited no more during the season, although the male was kept in the jar and placed in the cage outdoors at the same time with the female. The second female laid two eggs July 16 and one more on the 18th, the male dying July 22. The third female had no male companion until August 7, and laid no eggs whatever.

On examining the outdoor cage, May 10, 1897, a live beetle was found about four inches below the surface. The cage was covered, but before another examination was made the netting became partly detached and three of the beetles undoubtedly escaped, as only two females could be found in the ground May 17. They were quite active, and had partially eaten a full-grown white grub (*Lachnosterna* sp.?) which was in the cage. No remains of the other beetles could be found, although the ground was examined to the depth of nearly a foot. This shows conclusively that the beetles hibernate as adults.

The two female beetles were placed in separate breeding jars in the insectary and supplied with food, but very little was eaten until June 2, when males were placed in the jars. One female began laying June 6, finished July 14, having deposited eighty-one eggs, and died on the 24th. The other female began laying on the same date as the former, but finished June 25, dying July 3, having deposited one hundred and fifteen eggs. The largest number laid in a single day was nineteen, which is the maximum noted for this species. From the above it will be seen that these two females were kept in confinement for over a year, and that one, if not both, deposited eggs two years in succession. This naturally brings up the question of the number of annual broods of this insect. From the fact that the egg-laying season ranges from the first of June to the middle of August, I am inclined to believe from present knowledge that the greater portion of the species winter as adults which have seldom laid eggs the previous year.

Observations in the field show that after the last part of June the occurrence of this species is very rare. Mr. W. C. Colt, a special inspector of the Board, with the aid of two men captured thirty-one specimens of this species June 24, while at work in a colony of the gypsy moth in Brookline, and informs me that previous to and about this time the beetles were abundant. On the following day he noticed a female laying her eggs, for which purpose she had selected a place about half an inch below the surface of the ground. Mr. Colt further states that from a week after this date to the end of the season not a single beetle was observed. This species has also been found during the past year in Saugus, Winchester, Medford and elsewhere.

Jars partly filled with earth were used for close breeding with about the same amount of success as during the previous season, the results, however, substantiating the facts which were observed last year. Much of the material confined in jars was attacked by mites, while the outdoor experiments were rendered almost useless by the attacks of ants.

In order to test the practicability of rearing the beetles out of doors, a suitable spot was selected beside two small oak

trees, and a cage with a ground area of about a square yard was built. About the middle of June ten males and a like number of females of *frigidum* were placed in the cage, with plenty of caterpillars. Some of the beetles paired the following day, and on examining the ground June 28 a beetle larva was found. Subsequent examinations, however, failed to bring to light any larvæ, and, as ants were numerous in the cage, this doubtless accounts for the non-development of larvæ that may have hatched.

The killing of young beetle larvæ by the common black ant (*Camponotus pennsylvanicus* DeG.) has been previously noted. Several jars containing newly hatched larvæ of *C. frigidum* were accidentally left uncovered over night. In the morning seven of the eleven larvæ present had been killed, and the ants were feeding on the bodies. One hundred and six larvæ which were placed in another outdoor cage during the season suffered in the same manner from ants, and not one completed its transformations.

Some of the larvæ reared in jars until nearly full grown were placed in small cages out of doors, but they were so badly attacked by mites * that none pupated successfully. In one of these cages a larva of this species was attacked by a wire-worm (*Asaphes* sp. ?), the integument being ruptured so badly that the larva died.†

Calosoma scrutator (Fab.).

This beetle, known under the common names of beautiful-bodied searcher, rummaging or green Calosoma, has for years been recognized as one of the most useful predaceous insects. Almost every report on injurious insects credits it with preying upon noxious species. The following list of some of the injurious larvæ which this beetle has been known to attack has been compiled from various sources: —

Tobacco worms, *Protoparce* (sp. ?).
Gypsy moth, *Porthetria dispar* (pupa also).
Tent caterpillar, *Clisiocampa americana*.

* Through the kindness of Dr. L. O. Howard these mites have been determined by Mr. Nathan Banks as an immature stage of a species of *Histiostoma*.

† A somewhat similar occurrence has been mentioned by Riley in "Insect Life," vol. II., p. 299.

Forest tent caterpillar, *Clisiocampa disstria.*
Army worm, *Leucania unipuncta.*
Cotton worm, *Aletia argillacea.*
Lime tree winter moth, *Hybernia tiliaria.*
Spring canker worm, *Paleacrita vernata.*
Fall canker worm, *Anisopteryx pometaria.*
Oak Tortricid, *Cacœcia fervidana.*
Rocky Mountain locust, *Caloptenus spretus* (nymphs).

This shows *C. scrutator* to be a very general feeder, and that it is particularly fond of our common injurious lepidopterous larvæ. When kept in confinement at the insectary, single beetles killed on an average about four full-grown gypsy moth caterpillars daily. Out of doors the number killed would be increased, as the appetite of the beetles is greater under natural conditions than when kept in confinement.

Calosoma scrutator is found in Canada and the New England States, but is more locally than generally distributed. It is more common in New York and the Middle States, and occurs throughout the United States. Specimens were found this year in infested woodland in Saugus, and through the efforts of Mr. W. W. Stevens a number was received for rearing purposes. The first beetles were received and placed in breeding jars June 24. They fed readily and mated several times, but only seven eggs were laid during the season, six being laid by one female, June 26, and a single egg being deposited by another female, July 1. It is probable that this species, like the other Calosomas thus far observed, lay the bulk of their eggs earlier in the season, and it may be that the females had nearly finished depositing eggs before being placed in confinement.

A part of the eggs was preserved for further study, those remaining in the jar hatching in eight days; all the larvæ died, however, before molting. This species does not thrive in confinement as well as either *frigidum* or *calidum*. August 9 a coarse wire cage was constructed near the insectary, in which were placed nine females, which went into the ground immediately, without taking food. This cage will be examined in the spring, and notes on the hibernation of the species completed.

Calosoma willcoxi Lec.

This species was first described by Dr. Leconte in 1848. It is smaller than any of our *Calosomas* previously studied, and from its green color might be easily mistaken for a diminutive *scrutator*. The middle tibia of the male, however, is straight and not hairy, while that of the male *C. scrutator* is curved, and has a dense brush of hairs on the inner surface near the tip. It occurs in Canada and the United States and has been reported very abundant in Maryland, but is very rare in this vicinity. Its feeding habits are the same as those of the other members of the genus. Riley * reported it feeding on nymphs of the Rocky Mountain locust, and in Canada it has been found climbing the trees and feeding on canker worms.†

Only one specimen has been under observation this season. On June 9, Mr. C. E. Bailey, an agent of the Board, captured this beetle in Newton and brought it to the insectary in perfect condition, where it was confined in a breeding jar. The following day nine eggs were found about an inch below the surface of the earth; only one hatched, the others probably being infertile. The larva was deformed and very sluggish in movement, taking no food whatever, and died two days after hatching. No more eggs were laid, however, and June 30 the beetle went into the ground, where it remained, and ate nothing, until August 18.

The beetle was supplied with full-grown forest tent caterpillars (*Clisiocampa disstria*) and third and fourth molt gypsy moth larvæ, and consumed on the average about one larva per day. Female beetles, however, never eat as large an amount of food when isolated as when confined with males.

Although *willcoxi* has never been observed feeding on the gypsy moth in the field, from the fact that it occurs in the infested districts and feeds on the larvæ in confinement, it may be safely enumerated as an addition to the list of natural enemies of *P. dispar*.

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* First Report United States Entomological Commission, 1878, p. 314.

† Harrington, Report Entomological Society, Ontario, 1893, p. 24.

Calosoma calidum (Fab.).

On the 23d of May a male and female were placed under observation in a breeding jar, and were noted to pair on each of the three succeeding days. The first eggs were laid May 31; the female died July 24, after having deposited eighty-eight eggs. The larvæ hatched in about a week from the date of oviposition, and were isolated in jars and carefully fed daily. A large proportion reached the third larval stage in a healthy condition. At this time the same difficulty was experienced as last year, viz., the dying of the larvæ without any apparent cause.

Quite a number of the larvæ pupated, however, but on examining the jars a few days later the pupæ were found to be dead, having been attacked by mites.* A full-grown larva of *C. calidum*, which was found July 4, fed a few days and pupated in one of the breeding jars, but shared the same fate as the others.

Pterostichus lucublandus (Say).

This is one of our most common ground beetles, and is often found under stones or running about in the grass during the summer. While the members of this genus are considered to be predaceous on other insects, certain species have been charged with doing some damage by feeding on vegetation. This is probably true to some extent, but when these insects are abundant they doubtless do considerable good by feeding on noxious species.

A pair of *lucublandus* were taken *in coitu* under a large rock, June 2, 1897. They were placed in a breeding jar and fed with gypsy moth caterpillars. The smaller ones were devoured greedily, the larger ones, as a rule, being rejected. On July 4, however, I observed the male beetle attack a fourth molt larva of this species. The caterpillar was grasped just behind the head, and, after a fierce struggle, the beetle succeeded in cutting a hole through the integument and began to feed upon the internal portions with great

* Identified by Mr. Banks as "the nymph of some Oribatid, probably of the genus *Oribata*."

avidity. In addition to gypsy moth larvæ, other small caterpillars were provided, which they ate with apparent relish. A pupa of *Orgyia leucostigma* was also eaten by the beetles. The average consumption equalled about one small gypsy moth caterpillar daily. In killing noxious insects these beetles probably will not be found as helpful as some of the larger species of Carabidæ; although they take most of their food on the ground, they are sometimes taken under burlaps, thus indicating that they may also feed in trees.

On June 9 several eggs were found in the earth, from one-fourth to one inch below the surface. Eggs were also laid as follows: June 10, nine; 11, nine; 18, six; and on the 29th, three, — making a total of over thirty eggs deposited. After the last date no eggs were laid. August 19 the female beetle escaped in some unknown way, and the observations with the adults were discontinued. A few of the eggs hatched, but all the larvæ died before pupating.

HARPALUS CALIGINOSUS (Fab.).

This beetle has been often observed feeding on injurious insects. Among the common ones which have been most frequently noted in the literature are cut worms, army worms and the Colorado potato beetle in its different stages. Professor Riley * found that large numbers of nymphs of the Rocky Mountain locust were consumed by this beetle, while Dr. Howard † has noted that it feeds on the nymphs of another destructive locust, *Schistocera americana*. It is a fact, however, that the food of this beetle consists partly of vegetable matter. I have several times observed it feeding on the flower heads of *Ambrosia artemisiæfolia*, and it has been accused of eating wheat in the stack. Professor Forbes ‡ has discovered some interesting facts in regard to the food of this species by examining the stomach contents. Two specimens, collected in August and September, respectively, were found to have eaten 35 per cent. of animal mat-

* First Report United States Entomological Commission, 1878, p. 314.
† "Insect Life," Vol. VII., p. 228.
‡ Bulletin Illinois State Laboratory of Natural History, No. 6, 1883, p. 45.

ter, while the remainder was of vegetable origin. Of the animal matter, 20 per cent. could not be identified, 10 per cent. consisted of insect food, caterpillars and Diptera being represented, while the remaining 5 per cent. were mites. The vegetable food consisted chiefly of the tissue of grasses and a little pollen from flowers belonging to the family Compositæ. In addition to the above, the spores of a fungus (*Helminthosporium*) amounted to 3 per cent. This shows conclusively that vegetable food is taken freely during this time of year. The fact that the beetles eat such vegetable matter as pollen, seeds of common weeds and spores of fungi, should be counted in their favor rather than against them; and if they are able to subsist on such food during the season when caterpillars and noxious insects are scarce, it is indeed a wise provision. If, however, subsequent observations and investigations show that they actually feed to any great extent on wheat or other vegetable matter of economic importance, we shall be led to believe that their usefulness has in the past been over-estimated.

September 20 a pair of *H. caliginosus* was received from Mr. F. H. Mosher, an inspector of the Board. They were placed in a breeding jar with a larvæ of *Halesidota maculata* and flower head of ragweed. Another female found near the insectary was placed in the jar three days later. The beetles fed on the weed, eating chiefly the seeds, but did not molest the caterpillars. A pair copulated the following day, remaining *in coitu* about three minutes. They were then isolated, and two days later, September 26, seven eggs were found about three inches below the surface of the ground. Two eggs were deposited the following day, and on October 15, no more having been laid, the beetles were placed in a wire cage near the insectary, to obtain notes on their hibernation. The eggs, which were kept in the insectary, hatched in nineteen days from the date of oviposition. Some of these larvæ have also been placed in an outdoor cage for the winter, and an attempt will be made next year to complete the life history of this species.

THE SPECIES OF PODISUS OCCURRING IN THE UNITED STATES.

BY A. H. KIRKLAND, M.S.

As one of the natural checks upon the undesirable increase of many species of insects, the "soldier bugs" of the genus *Podisus* are of considerable economic importance. Arboreal in habits, almost entirely predatory and requiring daily a considerable amount of fresh food, they exert an influence which may entitle them to rank with the beneficial predaceous insects of any order. When disturbed, these bugs emit a decidedly unpleasant odor, and in their passage over berries sometimes impart to the fruit a most nauseating taste, a habit common to many bugs, and one that has given them a most disreputable popular name. Yet when we consider the fact that throughout the season of their activity these soldier bugs are daily destroying the caterpillars that strip our trees, the slugs that devour our potato vines and numerous other species that prey upon our cultivated crops, the occasional annoyance caused by these insects is of but trifling importance. In our work against the gypsy moth no other predaceous insects have been so commonly noticed destroying the caterpillars, and their attacks upon other injurious larvæ have been a matter of frequent observation. During the past four years, in connection with other work, the writer has had many opportunities to observe the feeding habits of our common species, and has published elsewhere, in detail, the life history of two members of this genus. The literature upon these most interesting insects is found in several languages and in the publications of both hemispheres. As a large part of it is somewhat difficult of access to the general student, it has seemed that a compilation of the known facts

concerning our native species might be of value in facilitating their identification.

The Genus Podisus.

This genus was established by Herrich-Schäffer in 1853 ("Wanzenartigen Insecten," Vol. IX., p. 296), to include a number of species having their fore femora unarmed, which, aside from this character, would properly fall into the genus *Canthecona.* At this time he described several species from Brazil, and in the list given in his "Index Hemipterorum Heteropterorum," published during the same year, enumerates some ten species of *Podisus*, among which is *P. luridus* Fab., which had formerly been placed in the genera *Pentatoma* and *Arma.* No type of the genus is designated by Herrich-Schäffer, but as *P. luridus* * is its sole European representative, and was included by him in the genus at the time of its establishment, this species may be properly taken as the generic type. The presence of the ventral spine excludes the species of *Podisus* from the genus *Arma*, under which several were originally described. Stål erected the genus *Telepta* in 1858 ("Bidr. Rio Jan. Hemip.," p. 10) but later transferred the species therein included to *Podisus* ("Enum. Hemip.," 1870, p. 48). In the latter work, *loc. cit.*, he divided the many species of the genus *Podisus* among the sub-genera *Troilus* Stål, *Apateticus* Dall., *Apoecilus* Stål, *Podisus* H. S. and *Tylospilus* Stål, his genus *Telepta* being given as a synonym of the sub-genus *Podisus.*

The genus *Podisus* may be characterized as follows: —

Head nearly quadrangular; basal segment of antenna stout, not reaching to the anterior margin of the head; rostrum stout. Scutellum triangular, extending but little beyond the middle of the abdomen, the apex reaching to or upon the membrane of the wing. Fore femora unarmed; fore tibiæ not dilated. Second abdominal segment with a spine of variable length extending anteriorly.

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* Professor Fernald has kindly given me a pair of *P. luridus.* This species is of about the same size as *P. spinosus*, but differs from any of the representatives of the genus in the United States in that the humeral angles are very prominent and rounded, almost lobate.

A large genus, represented by many species from North, Central and South America, the Antilles and by a single species from Europe and Asia.

Habits.

Before presenting generalities concerning the habits of our native species, it will be proper to say that the statements are based upon a general knowledge of the life histories of *P. serieventris*, *P. placidus*, *P. modestus* and *P. cynicus*. A more intimate knowledge of the early stages of all the species may lead to some changes in the statements here given. It may be remarked that apparently but little attention has been given by entomologists to the rearing of these predaceous insects, probably on account of the difficulty in supplying the young bugs with the fresh food they daily require.

The insects emerge from their hibernating quarters in the spring, at about the time the foliage appears. After feeding for a week or more upon the most abundant caterpillars, the eggs are laid on leaves or branches of trees. The young bugs hatch in the course of a week or two, molt four times, reach the imago state by midsummer, and lay eggs for a second brood, which matures early in the fall. In passing from the last nymph stage to that of the imago the number of joints of the tarsi and the antennæ is increased by one. In the case of the larger species, such as *P. cynicus*, there seems to be but one brood yearly in this latitude. Farther south the number of annual broods may be greater. Both sexes hibernate under leaves on the ground, under the bark of trees or in other sheltered places. The life of the female imagoes in captivity ends soon after the eggs have been deposited.

It has been stated, as a general rule, that the group of insects to which these bugs belong "will bear watching" so far as feeding habits are concerned. Many feed on plants, often to an injurious extent; some are entirely predaceous; while others feed on both plants and insects. The species of *Podisus* whose habits have been recorded feed upon insects almost entirely, and are very beneficial. It should be admitted that Dr. Fitch (Third Report Insects of New York,

1856, pp. 335, 336) includes *P. cynicus* and *P. spinosus* among the insects that attack the limbs of the apple, — a statement that Dr. Lintner (First Report Insects of New York, 1882, p. 331) very properly questions. It is equally doubtful if *P. modestus* attacks the grape vine, as stated by Fitch (*op. cit.*, p. 390); and it would seem possible that the statements of Glover and Saunders in regard to the attacks on plants by some of the above-mentioned species rest on Dr. Fitch's authority, and not on personal observations. Nearly two hundred specimens of our common species of *Podisus* have been collected by the writer and his assistants during the past four years, and in no case have any of these insects been found feeding on plants. When confined *P. serieventris* has been known to puncture the leaves of oak ("The Gypsy Moth," Forbush-Fernald, 1896, p. 402), a performance that has been observed but once. It should, however, be stated that a large part of the normal food of the newly hatched bugs seems to be the sap contained in leaves. So far as our observations extend, the nymphs after molting once are entirely predaceous.

Beneficial insects are so worthy of attention and praise that one may easily dilate upon their good qualities and overlook the harm they do. To state the case fairly with the genus *Podisus*, it will be proper to say that some of the species may occasionally devour a coccinellid beetle or other beneficial insect. Walsh has recorded a single case of the kind ("American Entomologist," 1868, p. 13). If this habit is a common one, we should probably have more records of it. The worst point that the writer has observed in the habits of the species is that when the food supply runs short they will devour each other ("The Gypsy Moth," p. 402). A glance over the list of insects each species is known to destroy will show which way the balance swings. The following table will aid in the separation of the species occurring in the United States: —

SYNOPSIS OF THE SPECIES.*

1.	Membrane with a distinct dark spot at tip,	2.
	Membrane without a dark spot,	5.
2.	Scutellum with a dark V-shaped spot,	*acutissimus.*
	Scutellum without such spot,	3.
3.	Humeral angles produced into slender spines,	*spinosus.*
	Humeral angles acute but not spinose,	4.
4.	Ventral spine very short, not reaching hind coxæ,	*modestus.*
	Ventral spine reaching to or upon hind coxæ,	*serieventris.*
5.	Lateral lobes of head longer than tylus (median lobe),	6.
	Lateral lobes of head not longer than tylus,	8.
6.	Humeral angles produced into stout spines,	*cynicus.*
	Humeral angles not spinose,	7.
7.	Humeral angles rounded, ventral spine very short,	*gillettei.*
	Humeral angles nearly right-angled, ventral spine long,	*crocatus.*
8.	Humeral angles spinose, curved toward head,	*mucronatus.*
	Humeral angles blunt and rounded,	*placidus.*

PODISUS PLACIDUS Uhler. (Plate 1, fig. 1.)

1869, (?) *Stiretrus fimbriatus* Saunders, Can. Ent., vol. II., p. 15.†
1870, *Podisus placidus* Uhler, Amer. Ent., vol. II., p. 203.
1870, *Arma placidum* Saunders, Can. Ent., vol. II., pp. 93, 94.
1872, *Podisus placidus* Lintner, Ent. Contrib., I., p. 150.
1872, *Podisus placidus* Saunders, Rep. Ent. Soc. Ont., p. 31.
1877, *Podisus placidus* Riley, 9th Rep. Ins. Mo., p. 17.
1889, *Podisus placidus* Saunders, Ins. Inj. to Fruits, p. 342.
1895, *Podisus placidus* Gillette-Baker, Bull. 31, Col. Agrl. Expt. Station, Hemipt. Col., p. 13.
1897, *Podisus placidus* Kirkland, Rep. Mass State Bd. Agr., pp. 399–404.
1897, *Podisus placidus* Uhler, *ibid.*, p. 403.
1897, *Podisus placidus* Kirkland, Can. Ent., vol. XXIX., p. 115.
1897, *Podisus placidus* Uhler, *ibid.*, p. 116.

Length: male, 9 mm.; female, 10 mm. Body ovate, yellowish brown; ground color creamy yellow, punctate with brick red. Head but little longer than wide, lateral margins dark brown; lateral lobes not longer than tylus, usually a little shorter; tylus punctate laterally, nearly bare in the middle. First segment of antennæ short, yellowish, darker outwardly; second segment

* *Podisus politus* Uhler (Ms.) of Uhler's check list (1886) has been suppressed as a name for a North American species (Uhler in litt.).

† The bibliography given for each species contains only such references as the writer has been able to verify personally.

slender, about three times as long as first; third segment but little more than one-half as long as second; fourth segment two-thirds as long as second; fifth segment a little shorter than fourth, dilated; all segments, except first, pale brownish, lighter at their outer ends. Rostrum pale yellow except at tip, reaching upon hind coxæ; second segment longest, passing front coxæ; third and fourth segments of nearly equal length, the latter brown. Pronotum sparsely punctate before, densely behind, the humeral angles; its anterior margin ivory yellow, bordered posteriorly with a double row of punctures; across the surface there are several transverse irregular wrinkles; sides oblique, straight or but slightly indented, with very minute teeth anteriorly. A pale callous line extends from the middle of the anterior margin to the tip of the scutellum. Post-humeral margins slightly sinuate, posterior margin bordered with an ivory-yellow line. Scutellum reaching to the membrane, sinuate behind the middle, where it is more densely punctate than elsewhere; tip white. Embolium and corium, except at base, densely punctate; clavus and base of corium sparsely punctate; a brownish callous spot occurs near the outer end of the corium; membrane pale bronze, translucent. Connexivum pale yellowish with faint black markings at incisures. Under-surface sulphur yellow with minute black markings laterally in some specimens. Ventral spine reaching the hind coxæ, ivory yellow. Legs rufous; tarsi brown. A black dot occurs at the tip of the osteolar canal and another in front of each eye.

Habits.

The life history of this species has been detailed in the last annual report of this committee. Briefly stated, the imagoes hibernate and appear early in the spring. They attack the larvæ of *Clisiocampa americana* Harr., and arter feeding for about a fortnight upon these and other insects, lay their eggs on the under sides of leaves or on twigs. From fifty to sixty eggs are laid by a single female. The eggs hatch in about ten days, and the red and black nymphs feed on the juices of the leaves for about a week, when the first molting takes place. From this time on the insects are predaceous. The second and third molts take place in twelve and ten days respectively; in the last nymph stage the head, thorax and wing-pads are intense pitchy black, the abdomen dark red, margined with a series of black spots, one on each segment. On the dorsum there are four black

spots placed in a longitudinal row. The last molt takes place in about three weeks.

The imagoes of the summer brood appear during July and those of the fall brood in September. While feeding upon the tent caterpillars in the spring this bug is frequently devoured by two spiders, *Epeira strix* and *Phidippus multiformis*, which are common occupants of the caterpillar webs.

The list of insects *P. placidus* is known to destroy includes *Pteronus ribesii* Scop. (Saunders, Can. Ent., 1870, pp. 93, 94), *Euvanessa antiopa* Linn., *Hyphantria cunea* Drury, *Orgyia leucostigma* S. and A., *O. definita* Pack., *Porthetria dispar* Linn., *Clisiocampa americana* Harr., *C. disstria* Hbn. (Kirkland, Report Massachusetts State Board Agriculture for 1896, p. 404.)

Distribution. — Canada, Massachusetts, New York,* Michigan,† Colorado.

Podisus gillettei Uhler. (Plate 1, fig. 6.)

1895, *Podisus gillettei* Uhler, Gillette-Baker, Bull. 31, Col. Agrl. Expt. Station, Hemip. Col., pp. 12, 13.

Prof. C. P. Gillette has been so kind as to send me the type and only known specimen of this beautiful species. Its prominent characters are: —

Length, 14 mm. Body ovate, like *P. placidus*, but much larger. Upper-surface dull olive colored, punctate with black. Head quadrangular, lateral lobes longer than tylus, but not as long as in *P. cynicus*. The sides of the tylus are margined anteriorly with yellowish. The entire upper surface of the head, aside from the preceding, is heavily punctate with black. First segment of antennæ not extending beyond lateral margin of head, yellowish; second segment hardly longer than head, testaceous; third segment two-thirds as long as second; fourth and fifth segments of nearly equal length, each about three-fourths as long as second, and, in common with the third segment, black except at base, which is yellowish. Rostrum of medium size, not as short as in *P. cynicus*, reaching upon middle coxæ. Second segment of rostrum reaching on the fore coxæ; third and fourth segments of nearly equal length; fourth segment piceous.

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* Specimen in Dr. Lintner's collection, labelled "Keene Valley, N. Y., July 4, 1890."

† Specimen in Museum of Comparative Zoölogy collection, labelled "Mich."

Pronotal margins very oblique, with finely incised edges anteriorly, with a broad ivory-yellow band, which diminishes at the humeral angles, which are very obtuse and rounded. The black puncturing on the anterior part of the pronotum is very dense; that on the posterior part less dense, arranged in irregular transverse lines. Scutellum but slightly sinuate, most densely punctured at base, and with a small callous spot in each basal angle. A fine callous line extends longitudinally through the pronotum and scutellum. Corium densely punctate; membrane bronzed, without apical spot. Connexivum ivory yellow, with faint black markings interiorly at segmental sutures. These markings do not reach the lateral edge of abdomen. Under-surface pale yellowish brown, punctate with darker brown. Abdominal spine very short, nearly obsolete. Legs of same color as under-surface, darkening on tibiæ to brown. Tarsi dark brown, hairy.

The stout rostrum indicates that this species has predaceous habits.

PODISUS MODESTUS (Dallas). (Plate 1, fig. 9.)

1851, *Arma modesta* Dallas, List, part I., pp. 101, 102.
1856, *Arma modesta* Fitch, 3d Rep. Ins. N. Y., p. 390.
1869, *Arma modesta* Walsh, Can. Ent., vol. II., p. 33.
1870, *Podisus modestus* Stål, Enum. Hemipt., part I., p. 51.
1872, *Arma modesta* Lintner, Ent. Contrib., I., p. 150.
1873, *Arma modesta* Riley, 5th Rep. Ins. Mo., p. 133.
1875, *Podisus modestus* Uhler, Bull. 5, vol. I., U. S. Geol. Surv. Terr., p. 283.
1876, *Podisus modestus* Glover, Manuscript Notes Hemipt. Het., p. 60.
1880, *Podisus modestus* Distant, Biol. Cent. Am. Rhync., vol. I., pp. 38, 39, pl. IV., fig. 4.
1884, *Podisus modestus* Fletcher, Can. Ent., vol. XVI., p. 215.
1885, *Podisus modestus* Fletcher, Rep. Ent. Soc. Ont., pp. 22, 77.
1889, *Podisus modestus* Lintner, 5th Rep. Ins. N. Y., p. 170.
1889, *Arma modesta* Saunders, Ins. Inj. to Fruits, p. 290.
1890, *Podisus modestus* Lintner, 6th Rep. Ins. N. Y., p. 189.
1890, *Arma modesta* Packard, 5th Rep. U. S. Ent. Com., p. 164.
1891, *Podisus modestus* Lintner, 7th Rep. Ins. N. Y., p. 353.
1892, *Podisus modestus* Riley-Howard, Insect Life, vol. IV., p. 123.
1895, *Podisus modestus* Gillette-Baker, Bull. 31, Col. Agrl. Expt. Station, Hemip. Col., p. 13.
1897, *Podisus modestus* Kirkland, Can. Ent., vol. XXIX., p. 115.

Length: male, 9.5 mm.; female, 10.5 mm. One of the smallest of our native species. Upper-surface densely and evenly punctate

with light brick red. Head much longer than wide, nearly truncate in front. The lateral lobes in a few specimens I have examined are a trifle longer than the tylus, but this seems to be an exception; outer margin of lateral lobes embrowned. Eyes very dark brown; ocelli minute, near occiput. First segment of antennæ very short, hardly reaching lateral margin of head; second segment slender, relatively short, but little over three times as long as first; third segment about three-fourths as long as second; fourth segment nearly as long as second; fifth segment longer than third, but a little shorter than fourth; all joints reddish or pale brown. Rostrum stout, reaching upon, sometimes to, posterior margin of hind coxæ; second segment the longest, third and fourth of equal length, the latter dark reddish brown. Pronotum deeply indented at the sides, margined with a fine yellowish white line, within which the puncturing is densely massed; anteriorly on the lateral margins there are several minute teeth; pronotal callosities obscure, thickly punctate outwardly. At the humeral angles the punctures are massed into a reddish spot, the angles being acute but not spinose. Scutellum sinuate, bare at apex, which reaches to the membrane; in nearly all specimens examined there is a minute bald spot at each basal angle of scutellum. Corium and embolium tinged with scarlet at their junction with membrane, which is bronzed and bears a dark-green marking at the tip. Under-surface pale yellowish, punctate with red, and bearing a row of four minute dots on the median line and two rows of similar dots laterally. Ventral spine very short, not reaching hind coxæ. Legs rufous.

Distribution. — Canada, Maine, Massachusetts, New York, Illinois, Georgia, Dakota, Nebraska, Colorado, Mexico.

The only species resembling *P. modestus* is the light variety of *P. serieventris*, which sometimes approaches the darker forms of the former species. The deeply sinuate humeral angles, the red marking at the tip of the corium, the light-colored tergum, the short ventral spine and short second segment of antennæ, — are characteristic of *modestus*, and will serve to distinguish it.

Habits.

This species is very common in May, feeding on tent caterpillars (*Clisiocampa americana* Harr.). At the Museum of Comparative Zoölogy, Cambridge, there are several specimens which were found under leaves by Mr. Jacob Boll in

the winter of 1872–73, thus proving that the insect hibernates as an imago. Different stages of the nymphs have been reared to imagoes at the insectary of the gypsy moth committee; but, owing to the amount of work involved, we have made no attempt to carefully follow the entire round of life, which apparently does not vary materially from that of *serieventris*. The imagoes are abundant in the spring, again in midsummer and also in September and October, and there can be no doubt that the species is here double-brooded. *P. modestus* is less common than *serieventris* or *placidus*, and, so far as my experience goes, is more frequently found on bushes and low-growing plants than on trees. In feeding habits it shows the same voracity as *serieventris*, and preys upon larvæ of all sizes. It has been recorded as destroying *Haltica bimarginata* Say (Lintner, Fifth Rep. Ins. N. Y., 1889, p. 170), *Haltica chalybea* Ill. (Lintner, Sixth Rep. Ins. N. Y., 1890, p. 189), *Hemileuca maia* Drury (Lintner, Ent. Contrib., I., 1872, p. 150), *Clisiocampa americana* Harr. (Kirkland, Can. Ent., 1897, p. 115), *Lygœonematus erichsonii* Hartig (Fletcher, Can. Ent., 1884, p. 215). In Professor Fernald's collection there is a specimen of *P. modestus* taken feeding on a leaf hopper at Amherst, Mass., May 28, 1890.

In September, 1896, Mr. Robert Cooley took a nymph of this bug at Brewster, Mass., feeding on the pupæ of the "yellow-headed fire worm," *Teras minuta*. The imago developed September 20. The writer has found *modestus* feeding on gypsy moth larvæ during the past summer at Saugus, Mass. A minute hymenopterous parasite, *Telenomus podisi* Ashm., has been reared from the eggs of this bug ("Insect Life," IV., p. 123, 1892).

Podisus pallens (Stål).

1859, *Arma pallens* Stål, Freg. Eug. Resa, p. 222.
1870, *Podisus pallens* Stål, Enum. Hemipt., part I., p. 51.
1875, *Podisus pallens* Uhler, Bull. 5, vol. I., U. S. Geol. Surv. Terr., p. 282.

Stål's description of this species may be translated as follows: —

Whitish yellow, somewhat punctate with brownish dots, more finely and less densely (punctate) beneath; antennæ darker towards the apex; posterior angles of thorax produced, subacute; scutellum not punctate at the lowest part of the apex; abdomen with each segment margined with a minute spot above and below at base and at apex, and with spots placed in series on both sides; femora tawny, with an apical dot.

I have been unable to obtain an example of this species and have not included it in the synopsis. The insufficiency of the original description was long ago pointed out by Professor Uhler in the following words: "The small differences in the lateral angles of the pronotum and in puncturing do not seem to me suffiicent to separate this from *P. modestus.*" The specimens from which the original description was prepared were collected in California.

PODISUS CROCATUS Uhler. (Plate 1, fig. 3.)

1878, *Podisus cynicus*, var. *obscuripes* (Uhl. Ms.) Riley, Rept. U. S. Dept. Agr., p. 245.
1884, *Podisus* * *crocatus* (Uhl. Ms.) Hagen, Can. Ent., vol. XVI., p. 40.
1897, *Podisus crocatus* Uhler, Trans. Md. Acad. Sc., pp. 384–386.

Through the kindness of Mr. Samuel Henshaw I have had the privilege of examining several representatives of this species at the Museum of Comparative Zoölogy, Cambridge, Mass. Professor Uhler has also kindly given me a specimen from Vancouver Island. I have nothing to add to Professor Uhler's excellent description of the species. Its prominent characteristics are: —

Length, 15 mm. Body robust, reddish yellow, heavily marked with dark-green punctures. Lateral lobes of head longer than tylus, and bordered outwardly with a fine dark-green line. First segment of antennæ stout, reaching about three-fourths the distance between eye and anterior margin; second segment about three times as long as first; third segment two-thirds as long as second; fourth segment one-third longer than third; fifth segment a trifle longer than third. Rostrum stout, reaching to hind coxæ; first segment thick; second segment but little longer than first;

* Misprinted "Podiscus."

third and fourth segments each nearly as long as first. Sides of pronotum coarsely serrate anteriorly; humeral angles nearly right angled, dark green. Scutellum punctate with dark green, reaching to the membrane. Corium of same color as scutellum; membrane bronze brown, extending beyond tip of abdomen. Connexivum orange, marked with dark green at the incisures. Under-side yellowish, punctate with brick red laterally. Legs amber colored, darkening toward the tarsi. Ventral spine stout, nearly passing the hind coxæ.

In size this species resembles *P. cynicus*, from which it may be distinguished by its orange-colored body with dark-green markings, and humeral angles which are not as acute as in that species.

Distribution.—Vancouver Island, Washington, Oregon, California.

Habits.

In July, 1882, Mr. Samuel Henshaw collected a number of imagoes of this species and three nymphs near Loon Lake, Washington. These insects were feeding on the larvæ of *Neophasia menapia* Feld. Aside from a darker coloration, the nymphs bear a striking resemblance to those of *P. cynicus*. Being certainly an immature stage of a large *Podisus*, taken at the same time and place with the imagoes of *P. crocatus*, there can be but little doubt that they are the nymphs of this species, and may be described as follows:—

Podisus crocatus (?) nymph.

Length, 11 to 14 mm. Body compact, very stout, widest at middle of abdomen. Head and thorax heavily marked with dark bronze green. Abdomen thickly covered with scarlet dots. Head distinctly emarginate in front, edges at least bordered with dark green; a scarlet line extends along the inner margin of the lateral lobes, and also on median line from between the eyes backward to pronotum. First segment of antennæ stout, slightly projecting beyond the lateral margin of the head; second segment nearly as long as third and fourth taken together, these latter being of nearly equal length; all segments dark bronze green. Rostrum very stout, extending to middle coxæ; tip dark brown, horny. Edges of prothorax, scutellum and wing-pads heavily bordered with dark green. Irregular scarlet markings occur on either side of the dorsal groove of the prothorax, on the scutellum and on the wing-

pads; the extent of these markings varies inversely with that of the green ones. One specimen has no red on the scutellum or wing-pads, and but two small spots on the prothorax; while on the other specimens the red predominates. On the dorsum of the abdomen there is a longitudinal row of four transverse dark-green spots, while around the margin at the middle of each segment there is a semi-elliptical spot of dark green; included in each of these marginal spots is a much smaller spot of similar shape, pale buff in color. Under-side pale buff, dotted with scarlet. Femora and tibiæ reddish brown; tarsi dark green.

In a note on the enemies of *Neophasia menapia*, Hagen has written: "*Podisus crocatus* Uhl. (Ms.) is a very eager enemy of the pupa and the caterpillar before pupating, when it is very sluggish. The *P. crocatus* was everywhere common in the devastated forests, and observed in the act of sucking caterpillars" (Can. Ent., XVI., p. 40).

The above, and Riley's record of this species * feeding on *Diapheromera femorata* Say, are the only references to the habits of this insect I have been able to find.

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* Given as *P. cynicus* var. *obscuripes*, which name Professor Uhler writes me he has rejected in favor of *P. crocatus*.

Podisus cynicus (Say). (Plate 1, fig. 7.)

1831, *Pentatoma cynica* Say, Descr. New. Sp. Het. Hemip. of N. A., p. 8, New. Harm., Ind.*
1851, *Arma grandis* Dallas, List, part I., pp. 96, 97.
1856, *Arma grandis* Fitch, 3d Rep. Ins. N. Y., p. 335, pl. 2, fig. 7.
1856, *Arma bracteata*, Fitch, *ibid.*, p. 336.
1857, *Pentatoma cynica* Fitch, 4th Rep. Ins. N. Y., p. 757 (reprint of Say's description).
1859, *Pentatoma cynica* Say, Compl. Writ., vol. I., p. 312.
1867, *Podisus grandis* Stål, Öfvers. Vet. Ak. Förh., p. 497.
1870, *Podisus grandis* Stål, Enum. Hemipt., part I., p. 49.
1870, *Podisus bracteatus* Stål, *ibid.*, p. 54.
1870, *Podisus cynicus* Stål, *ibid.*, p. 54.
1874, *Arma grandis* Glover, Rep. U. S. Dep. Agr., p. 123.
1875, *Podisus cynicus* Glover, Rep. U. S. Dep. Agr, p. 118, fig. 8.
1875, *Podisus cynicus* Uhler, Bull. 5, vol. I., U. S. Geol. Surv. Terr., p. 282.
1876, *Podisus cynicus* Glover, Manuscript Notes Hemip. Het., p. 59, pl. II., fig. 29.
1876, *Arma bracteata* Glover, *ibid.*, p. 60.
1876, *Podisus cynicus* Uhler, Proc. Bost. Soc. Nat. Hist., p. 370.
1877, *Podisus cynicus* Glover, Entomological Index, pp. 8, 58.
1878, *Podisus cynicus* Riley, Rep. U. S. Dep. Agr., p. 245.
1878, *Podisus cynicus* Uhler, Bull. 2, vol. IV., U. S. Geol. Surv. Terr., p. 504.
1882, *Podisus cynicus* Lintner, 1st Rep. Ins. N. Y., p. 331.
1884, *Podisus bracteatus* Lintner, Can. Ent., vol. XVI., p. 182.
1884, *Podisus cynicus* Lintner, *ibid.*
1884, *Podisus cynicus* Uhler, Standard Nat. Hist., pp. 291, 292.
1885, *Podisus cynicus* Lintner, Rep. Ent. Soc. Ont., p. 13.
1885, *Podisus cynicus* Riley, 4th Rep. U. S. Ent. Com., p. 97.
1890, *Podisus bracteatus* Cockerell, Can. Ent., vol. XXII., p. 59.
1890, *Podisus cynicus* Lintner, Pop. Gardening, p. 198.
1891, *Podisus cynicus* Lintner, 7th Rep. Ins. N. Y., p. 356
1894, *Podisus cynicus* Fernald, Rep. Mass. State Bd. Agr., p. 260.
1895, *Podisus cynicus* Gillette-Baker, Bull. 31, Col. Agrl. Expt. Station, Hemip. Col., p. 12.
1895, *Podisus bracteatus* Gillette-Baker, *ibid.*
1896, *Podisus cynicus* Kirkland, The Gypsy Moth, Forbush-Fernald, pp. 392, 394, 402.
1897, *Podisus cynicus* Kirkland, Can. Ent., vol. XXIX., p. 115.

Length: male, 14.6 mm. to 17.8 mm.; female, 15 mm. to 18.8 mm. Tawny yellow, punctured with brick red or reddish-brown dots. Head longer than wide; lateral lobes longer than

* This rare pamphlet is in the library of the Boston Society of Natural History.

tylus. Eyes dark brown; ocelli vermilion, in rear of eyes, nearer median line. First segment of antennæ stout, extending about three-fourths of the distance between the eye and anterior margin of head; second segment a little more than three times as long as first; third segment two-thirds as long as second; fourth segment a trifle longer than third; fifth segment of about the same length as fourth. Rostrum very stout, reaching to hind coxæ; first segment wide and thick; second segment one-third longer than first, enlarging at its junction with third segment, which is of about the same length as first; fourth segment a little shorter than third, terminating in a blunt brown point. Pronotum and scutellum of same color as head. Sides of pronotum sinuate, with fine granular teeth anteriorly; humeral angles produced into stout acute spines. The callous spots on the anterior part of pronotum bear one or more small green markings; in some specimens there are small spots of this color at the anterior angles of the pronotum and at the inner ends of the callous spots. Scutellum sinuate behind its middle, reaching slightly upon the membrane. Corium of same color as scutellum; membrane bronze brown, extending beyond tip of abdomen. Connexivum orange, marked with black at the incisures. Under-surface pale yellow, dotted more or less with red. Legs of same color as under-surface, darkening slightly in some specimens towards the tarsi. Ventral spine very stout, reaching to middle coxæ.

Distribution. — Massachusetts, New York, Pennsylvania, Maryland, Illinois, Wisconsin, Dakota, Nebraska, Missouri, Colorado, Arizona.

Podisus bracteatus, as described by Fitch, differs from *cynicus* only in certain small green markings on the pronotum, scutellum and wing-covers. In our collection there is a series of thirty-seven specimens which shows nearly all the variations between the two species as described. Being unable to distinguish between the species, I tried to obtain specimens of *bracteatus* from several sources, but was unable to do so. In this difficulty I wrote to Professor Uhler, and found that he also was not familiar with this species. Since that time he has very kindly gone to the trouble to examine the specimen of *bracteatus* in the Fitch collection at the National Museum, and has decided that it is but a variety of Say's *cynicus*. Glover in 1876 expressed the opinion that *bracteatus* was but a variety of *cynicus* (Manuscript Notes

Hemip. Het., p. 60), an opinion also held by Dr. Lintner (Report Entomological Society, Ontario, 1885, p. 13), but which appears to have been overlooked by later writers.

Aside from the variations in the green markings on the thorax previously referred to, the color of the punctures on the upper-surface ranges from brick red to dark brown. The only aberrations in form that I have seen are two specimens, one of which has both humeral angles blunted off and actually *emarginate*, the other having the right humeral angle normal, the left being rounded. Both these insects were bred from nymphs, and their peculiarities of structure may be due to defective nutrition or to some accident at the time of the last molt, while the body was still soft.

Habits.

The imagoes of this species hibernate under leaves. At the Museum of Comparative Zoölogy, Cambridge, there are several specimens collected by Mr. Boll during the winter of 1872–73. These were sifted out from a quantity of leaves raked from the ground. The eggs and early nymph stages are unknown to the writer. Nymphs in the last stage have been taken frequently during June, July and August, and are known to feed on the larvæ of the gypsy moth. They may be described as follows: —

Podisus cynicus nymph.

Length, 10 mm.; greatest width, 8 mm. Body compact, somewhat elliptical in outline; head deeply inserted in the thorax. Posterior angles of thorax produced for a short distance along the sides of the abdomen. General color of head and thorax pale yellowish brown, sometimes marked with red. A fine dark seal-brown line extends around the margin of the head, thorax and wing-pads, and borders the tylus. From near the middle of the inner margin of each wing-pad a fine dark-brown line extends obliquely outward and backward to the outer margin, enclosing a somewhat diamond-shaped area, and marking the anterior margin of the future wing membrane. The median sulcus of the prothorax and scutellum is bordered with dark brown, and the surface of the thorax is finely punctured with faint brown dots. On either side of the dorsal sulcus of the prothorax there is a short, irregular, transverse black line, extending obliquely backward

toward the lateral margin. Abdomen brick red, bordered with heavy black line. At the middle of the lateral margin of each segment there is a well-defined semi-elliptical yellowish-brown spot, bordered with black. There are four more or less confluent, transverse dark-brown spots on the dorsum. Under-surface of head and thorax amber colored; color of abdomen somewhat lighter than that of the upper-surface. Antennæ four-jointed, black; first segment stout, partially retracted beneath the edge of the head; second segment slightly flattened, widened toward its outer end and four times as long as the first; third and fourth segments of nearly equal length, the latter being constricted at each end. Femora amber colored; tibiæ with three equidistant longitudinal ridges, pale brown and sparsely hairy; tarsi two-jointed, dark brown and hairy.

From the late appearance of the nymphs, it is probable that the species has but one annual brood in this region. Both nymphs and imagoes are rapacious feeders, their stout beak being a very formidable weapon. The insect attacked is impaled by a sudden thrust of the setæ, which hold it firmly, and in a few minutes the body fluids are sucked out. In killing large insects the setæ are sometimes wrested from the rostrum, but are readily replaced by the bug. The setæ can be moved by muscles at their base independent of the rostrum, and are armed with formidable reflexed spines.

The records of insects destroyed by this species include *Diapheromera femorata* Say (Riley, Rep. U. S. Dep. Agr., 1878, p. 245), *Podisus serieventris* Uhl. (Kirkland, "The Gypsy Moth," Forbush-Fernald, 1896, p. 402), *Doryphora decem-lineata* Say (Glover, Ent. Index, 1877, p. 8), *Porthetria dispar* Linn. (Fernald, Rep. Mass. State Bd. Agr., 1894, p. 260), *Aletia argillacea* Hbn. (Riley, Fourth Rep. U. S. Ent. Com., 1885, p. 97), *Pteronus ribesii* Scop. (Lintner, Can. Ent., 1884, p. 182).

PODISUS SERIEVENTRIS Uhler. (Plate 1, fig. 2.)

1870, *Podisus serieventris* Uhler, Proc. Bost. Soc. Nat. Hist., p. 94.
1876, *Podisus serieventris* Uhler, Proc. Bost. Soc. Nat. Hist., p. 370.
1892, *Podisus spinosus* Fernald, Rep. Mass. State Bd. Agr., p. 298.
1892, *Podisus spinosus* Fernald, Bull. 19, Mass. Hatch Expt. Station, p. 116.
1892, *Podisus spinosus* Riley-Howard, Insect Life, vol. IV., p. 354.
1894, *Podisus serieventris* Fernald, Rep. Mass. State Bd. Agr., p. 260.
1895, *Podisus serieventris* Gillette-Baker, Bull. 31, Col. Agrl. Expt. Station, Hemipt. Col., p. 13.
1896, *Podisus serieventris* Kirkland, The Gypsy Moth, Forbush-Fernald, pp. 393–403.
1897, *Podisus serieventris* Kirkland, Can. Ent., vol. XXIX., p. 115.

Length: male, 10–11 mm.; female, 11–12 mm. Upper-surface pale yellowish, heavily punctate with dark brown. Head truncate anteriorly, densely punctate on its anterior part. Eyes dark brown; ocelli minute, reddish, in rear of eyes. First segment of antennæ short, blackish outwardly, scarcely projecting beyond the lateral margin of head; second segment spread over with black, slender, dilated at apex, about four times as long as first; third segment a little over half as long as second; fourth segment two-thirds as long as second, and with the third generally spread over with black; fifth segment a little longer than fourth, reddish brown. Rostrum of medium thickness, reaching to hind coxæ; the first, third and fourth segments of nearly equal length, the second the longest, reaching to posterior margin of fore coxæ. Pronotum finely toothed anteriorly, indented laterally, but not as much as in *modestus*. The punctures are massed at the anterior and humeral angles into four blackish spots. Humeral angles acute, but not spinose, often slightly curved backward; on the pronotum of many specimens there are fine transverse wrinkles. Scutellum of same color as pronotum, less densely punctate at tip, which is sometimes whitish; at the basal angles in some specimens there is a small bald whitish spot. Corium more densely punctate than embolium; membrane bronzed, with a dark spot at the tip. Under-surface pale yellowish, marked and clouded with darker shades and sparingly punctate with reddish; on the middle of the last segment there is a round or oval black spot, above which in a longitudinal row there are often three minute black spots; laterally there are two rows of small black spots, occurring as follows: one on the middle of each segment, near connexivum, and one on the anterior margin of the third to

sixth segments inclusive, this latter row being equidistant between the ventral row and the connexivum; there is a large black dot at the tip of the osteolar canal and a smaller one on the pleuræ above each of the coxæ. Legs rufous; femora with two or three black dots near apex. Ventral spine ivory white, reaching upon the hind coxæ.

Distribution. — Maine, Massachusetts, New York,* New Jersey,† Minnesota, Colorado.

Habits.

Perhaps on account of its obscure coloring and active flight this species may be better protected from bird enemies than its congeners. Be that as it may, *serieventris* in this region is by far the most common representative of the genus. Hibernating as imagoes, the insects appear early in the spring, sometimes in April, and by the latter part of May an inspection of the webs of the tent caterpillar will show numbers of these bugs breaking their winter's fast upon the inmates of these webs. After a week or more spent in feeding, mating occurs,‡ and in a few days the female deposits her eggs in two or three clusters on the under-sides of leaves or on small branches. From fifty to sixty caldron-shaped eggs are laid by each female, and in about eight or ten days' time the gaily colored nymphs emerge from the egg-shells and commence feeding on the sap of leaves. If weather conditions are favorable, the first molt takes place in four or five days, and the nymphs wander forth in search of insects. These tiny creatures, not over 4 mm. in length, will destroy caterpillars many times larger than themselves. The second molting occurs about ten days after the first, and the third about six days later than the second. The red and black nymphs feed almost continually during this stage, and boldly attack the largest larvæ. From twelve to seventeen days elapse before the last molt. By midsummer the eggs for a second brood are laid, the imagoes of which appear in August and September. In 1895 the data concerning the times at which the imagoes and nymphs

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* In Dr. Lintner's collection.

† Specimens from Prof. J. B. Smith.

‡ These insects frequently mate in the fall ("The Gypsy Moth," p. 403).

appeared seemed to indicate the occurrence of three annual broods. There are certainly two broods each year in this region. The time at which different individuals of this species appear varies to such a degree that imagoes may be taken during every month from April to October, and only by rearing can we get at the actual number of broods. As recorded elsewhere, the writer has reared two broods between the latter part of June and the last of September.

This species is known to feed upon the following larvæ: *Porthetria dispar* Linn. (Fernald, Rep. Mass. St. Bd. Agr., 1892, p. 298), *Euvanessa antiopa* Linn., *Hyphantria cunea* Drury, *Attacus promethea* Drury, *Clisiocampa americana* Harr., *C. disstria* Hbn., *Paleacrita vernata* Pack.; in confinement we have reared it upon *Cimbex americana* Leach, *Datana ministra* Drury, *Attacus cecropia* Linn., *Telea polyphemus* Cram., *Anisota senatoria* S. and A., *Dryocampa rubicunda* Fabr., *Tolype velleda* Stoll, *Rhynchagrotis alternata* Grote, *Noctua c-nigrum* Linn. *P. serieventris* has been known as imago to kill the nymphs of its own species and of *P. cynicus*. In one case it was seen to feed on an imago of *Menecles insertus* Say (Kirkland, "The Gypsy Moth," Forbush-Fernald, 1896, p. 402).

PODISUS SPINOSUS (Dallas). (Plate 1, fig. 4.)

1851, *Arma spinosa* Dallas, List, part I., p. 98.
1856, *Arma spinosa* Fitch, 3d Rep. Ins. N. Y., p. 336.
1866, *Arma spinosa* Glover, Rep. U. S. Dep. Agr., p. 43.
1868, *Arma spinosa* Walsh-Riley, Amer. Ent., vol. I., pp. 13, 14, 37, 46, 59.
1869, *Arma spinosa* Riley, 1st Rep. Ins. Mo., pp. 77, 89, 113.
1869, *Arma spinosa* Walsh, Can. Ent., vol. II., p. 33.
1870, *Arma spinosa* Riley, 2d Rep. Ins. Mo., p. 32.
1870, *Arma spinosa* Shimer, Am. Nat., p. 98.
1870, *Podisus spinosus* Stål, Enum. Hemipt., part I., p. 51.
1871, *Arma spinosa* Kridelbaugh, Rep. Ia. State Hort. Soc., pp. 167, 168.
1871, *Arma spinosa* LeBaron, 1st Rep. Ins. Ill., pp. 64, 66, 162.
1871, *Podisus spinosus* Uhler, U. S. Geol. Surv. Terr. (Hayden), p. 395.
1872, *Arma spinosa* Lintner, Ent. Contrib., I., p. 150.
1872, *Arma spinosa* Riley, 4th Rep. Ins. Mo., p. 20.
1873, *Arma spinosa* LeBaron, 3d Rep. Ins. Ill., p. 184.
1874, *Arma spinosa* Glover, Rep U. S. Dep. Agr., p. 123.

1874, *Arma spinosa* Lintner, Count. Gent., p. 471.
1875, *Podisus (Arma) spinosus* Glover, Rep. U. S. Dep. Agr., p. 118, fig. 9.
1875, *Arma spinosa* Riley, The Garden (London), vol. VIII., p. 71.
1875, *Podisus spinosus* Uhler, Bull. 5, vol. I., U. S. Geol. Surv. Terr., p. 282.
1876, *Podisus spinosus* Glover, Manuscript Notes Hemipt. Het., p. 60.
1877, *Podisus spinosus* Glover, Entomological Index, pp. 8, 58.
1878, *Arma spinosa* Riley, Rep. U. S. Dep. Agr., p. 245.
1878, *Podisus spinosus* Thomas, 2d Rep. Ins. Ill., p. 218.
1879, *Arma (Podisus) spinosus* Comstock, Rep. U. S. Dep. Agr., p. 289.
1880, *Podisus spinosus* Fuller, Amer. Ent., vol. III., p. 190.
1880, *Arma spinosa* Packard, Guide to Study of Ins., p. 547.
1882, *Podisus spinosus* Lintner, 1st Rep. Ins. N. Y., p. 331.
1884, *Arma spinosa* Murtfeldt, Rep. U. S. Dep. Agr., p. 417.
1884, *Arma spinosa* Osborn, Can. Ent., vol. XVI., p. 151.
1885, *Podisus spinosus* Lintner, 2d Rep. Ins. N. Y., p. 146.
1885, *Arma spinosa* Osborn, Rep. Ent. Soc. Ont., p. 34.
1885, *Podisus spinosus* Riley, 4th Rep. U. S. Ent. Com., pp. 97, 98.
1886, *Podisus spinosus* Riley, Rep. U. S. Dep. Agr., p. 527.
1887, *Podisus spinosus* Riley, Shade Trees and their Insect Defoliators, p. 45.
1889, *Podisus spinosus* Saunders, Ins. Inj. to Fruits, p. 73.
1890, *Podisus spinosus* Lintner, 6th Rep. Ins. N. Y., p. 137.
1890, *Podisus spinosus* Packard, 5th Rep. U. S. Ent. Com., p. 194.
1890, *Podisus spinosus* Riley, 5th Rep. U. S. Ent. Com., p. 252.
1892, *Podisus spinosus* Riley-Howard, Ins. Life, vol. IV., p. 124.
1892, *Podisus spinosus* Riley, Rep. U. S. Dep. Agr., p. 167.
1893, *Podisus spinosus* Ashmead, Bull. 45, U. S. Nat. Mus., Proctotrypidæ, pp. 159, 163.
1893, *Podisus spinosus* Lintner, 8th Rep. Ins. N. Y., pp. 238, 300.
1893, *Arma spinosa* Lintner, 9th Rep. Ins. N. Y., p. 457.
1895, *Podisus spinosus* Gillette-Baker, Bull. 31, Col. Agrl. Expt. Station, Hemipt. Col., p. 13.
1896, *Podisus spinosus* Chittenden, Year Book U. S. Dep. Agr., p. 346.
1897, *Podisus spinosus* Howard, Bull. 5, Tech. Ser., Div. Ent., U. S. Dep. Agr., Ins. Parasitism, p. 8.

Length, 11 to 14 mm. Upper-surface yellowish, so heavily punctured with reddish or dark brown as to give the insect a general dull-brown color. Head nearly truncate in front; in some specimens the lateral lobes are a trifle shorter than tylus; punctures very close together on lateral lobes, more scattering on tylus. Eyes dark brown; ocelli minute, red, in rear of eyes and near the anterior margin of pronotum. Antennæ slender; first segment

short, scarcely projecting beyond the lateral margin of head, pale brown on its outer lateral surface; second segment slender, enlarging at its apex, four times as long as first, rufous at base, darkening toward apex; third segment about two-thirds as long as second, and of same color; fourth segment a little longer than third, similarly colored; fifth segment as long as third, rufous, sometimes tinged with brown at the apex. Rostrum stout, reaching to hind coxæ; first segment thick, half as long as upper-surface of head; second segment one-half longer than first, nearly passing anterior coxæ; third segment a trifle longer than first; fourth segment of same length as first, embrowned at tip. Sides of pronotum indented, with fine granular teeth anteriorly; humeral angles often sinuate posteriorly and produced into long slender spines, which are frequently tipped with dark brown or black. The puncturing is closely massed at each anterior angle of the pronotum and in a small spot at the outer end of the pronotal callosities. A fairly well-defined dorsal line extends from the anterior margin of the pronotum to the tip of the scutellum. Scutellum of same color as pronotum, reaching to the membrane, less densely punctured toward the tip. Corium of same color, generally tinged with red near the cuneus; membrane translucent with a brownish spot at the tip. Connexivum pale orange, with large black markings at each incisure; in the middle of these markings there is usually a minute white spot. Under-side pale yellowish, punctate sparingly with red or brown; on the middle of the last segment there is a large oval black spot, anterior to which on some specimens there is a minute black dot; a small black dot occurs on the third, fourth, fifth and sixth segments; these dots form a row which is equidistant between the median line and the lateral margin; osteolar canal tipped with a black dot. Legs of same color as abdomen, femora generally tipped with two dark-brown dots. Ventral spine slender, reaching upon the hind coxæ.

Distribution. — Canada, Massachusetts, New York, Pennsylvania, Maryland, Virginia, Wisconsin, Illinois, Nebraska, Kansas, Iowa, Missouri, Colorado, Indian Territory, Texas, California. This species is stated to occur generally throughout the south and west; it is rare in Massachusetts.

Habits.

Podisus spinosus has been frequently confounded with *P. serieventris* in the collections I have examined, and in

some series the two species closely approach each other. *P. spinosus* usually reaches a size not attained by *serieventris*. In the latter species the antennæ are generally spread over with brown and the humeral angles are bluntly acute, not produced into slender spines. In *spinosus* there is usually a well-defined sinuation in rear of each spine.

The life history of this species, as briefly given by Riley, is as follows: —

> The eggs of *P. spinosus* . . . are bronze-colored, caldron-shaped objects, with a convex lid, around which radiate fifteen or sixteen white spines. They are attached side by side, in clusters of a dozen or more, to leaves and other objects. . . . The young bug is ovoid, shiny black, with some bright crimson about the abdomen. In the full-grown larva . . . four yellowish spots appear on the thorax, and the abdomen becomes more yellowish. In the so-called pupa, distinguished by wing-pads, the ochre yellow extends still more, and in the perfect insect the black entirely disappears. In the immature stages the shoulders are rounded, not pointed; the antennæ are four-jointed instead of five-jointed as in the adult, and the feet or tarsi have but two joints instead of three.
>
> The diet of the young seems to be principally vegetarian, but we have mentioned elsewhere (Fourth Rep. Ins. Mo., p. 20) instances where the larva has been seen to destroy larvæ of the Colorado Potato beetle four or five times its own size. (Fourth Rep. U. S. Ent. Com., p. 98.)

At the time the Colorado potato beetle was spreading eastward, *P. spinosus* was perhaps its most frequently observed insect enemy, as is shown by its frequent mention in articles on the subject appearing at that time, and its services in destroying this beetle were of sufficient value to call out the commendation of many entomologists. In destroying the cotton worm (*Aletia argillacea*) Riley rates this bug as "the most abundant and effective" of the Heteroptera known to attack the insect. The full list of insects which *P. spinosus* is known to attack is given below: —

Diapheromera femorata Say (Riley, Rep. U. S. Dep. Agr., 1878, p. 245), *Coccinella* sp.? (Walsh, Amer. Ent., 1869, vol. I., p. 13), *Crioceris asparagi* Linn. (Chittenden, Year Book U. S. Dep. Agr., 1896, p. 346), *Doryphora decem-*

lineata Say (Glover, Rep. U. S. Dep. Agr., 1866, p. 43, and many other writers), *Galerucella luteola* Müll (Riley, Rep. U. S. Dep. Agr., 1892, p. 167), *Pieris rapæ* Linn. (Murtfeldt, Rep. U. S. Dep. Agr., 1884, p. 417), *Hyphantria cunea* Drury (Walsh, Amer. Ent., vol. I., 1869, p. 59), *Orgyia leucostigma* S. and A. (Howard, Bull. 5, Tech. Ser., 1897, p. 8), *Carneades scandens* Riley (Riley, First Rep. Ins. Mo., 1869, p. 77), *Aletia argillacea* Hbn. (Comstock, Rep. U. S. Dep. Agr., 1879, p. 289), *Cacœcia fervidana* Clem. (Packard, Fifth Rep. U. S. Ent. Com., 1890, p. 194), *Carpocapsa pomonella* Linn. (Le Baron, 3d, Rep Ins. Ill., 1873, p. 184), *Gymnonychus appendiculatus* Hartig (Glover, Rep. U. S. Dep. Agr., 1875, p. 118), *Selandria barda* Say (Osborn, Can. Ent., 1884, p. 151).

Telenomus podisi Ashm. (Ashmead, Proctotrypidæ, 1893, p. 159) and *Trissolcus podisi* Ashm. (*ibid.*, p. 163) have been reared from the eggs of *P. spinosus*.

Podisus acutissimus Stål. (Plate 1, fig. 5.)

1870, *Podisus (Tylospilus) acutissimus* Stål, Enum. Hemipt., part I., p. 53.
1875, *Tylospilus acutissimus* Uhler, Bull. 5, vol. I., U. S. Geol. Surv. Terr., p. 283.
1880, *Podisus acutissimus* Distant, Biol. Cent. Am. Rhync., vol. I., pp. 40, 41, pl. II., fig. 22.
1895, *Podisus acutissimus* Gillette-Baker, Bull. 31, Col. Agrl. Expt. Station, Hemipt. Col., p. 12.

Length, 9 mm. Very pale olive yellow, heavily punctate with dark brown on posterior part of pronotum and lower part of scutellum. Head somewhat narrowed anteriorly. Tylus longer than lateral lobes, which are obliquely rounded and margined with dark brown at their outer ends. Between the dark-brown eyes and extending backward to the pronotum are two longitudinal dark-brown markings. First segment of antennæ small, scarcely projecting beyond the lateral margin of head, pale yellow, darkened outwardly; second segment of antennæ slender, dark brown; third segment three-fourths as long as second, reddish yellow, dark brown at base; fourth segment as long as third, testaceous; fifth segment two-thirds as long as fourth, testaceous, darker toward the apex. Rostrum slender, reaching upon middle coxæ; the second segment scarcely reaching the fore coxæ, pale amber colored.

Pronotum with an irregular ivory-yellow callous on the dorsum anteriorly; lateral margins with fine granular teeth. Humeral angles very acute, terminating in slender spines which project anteriorly. A well-marked band of dark-brown punctures extends across the pronotum between the humeral angles, darkening to black at the posterior margin. Post-humeral margins oblique and curved.

There is a large ivory-yellow bald spot in each basal angle of the scutellum, flanked outwardly by a minute brown callous and inwardly by scattering brown punctures which extend in a band across the scutellum. Behind these spots and separated from them by a pale olive-yellow band is a well-defined dark-brown V-shaped marking, posterior to which at the tip of the scutellum there is an ivory-yellow crescent-shaped marking.

Corium pale olive yellow, with a black dot outwardly nearly opposite the apex of the V-shaped marking. Membrane glassy, with a large dark-brown marking. Connexivum olive yellow, without dark markings. Under-surface without conspicuous markings, pale amber colored anteriorly, darkening to olive yellow posteriorly. Ventral spine very long, reaching middle coxæ. Legs amber colored; tarsi pale brown.

Prof. Carl Baker of Auburn, Ala., has very kindly sent me a specimen of *P. acutissimus* from Texas. This species is the most conspicuously colored of any that I have examined, and may be recognized by the V-shaped marking and bald spots on the scutellum, the transverse brown band and sharp, curved spines of the pronotum, the vitta of the membrane and the long ventral spine.

Distant has figured a specimen having a bald spot at the middle of the base of the scutellum (Biol. Cent. Amer. Rhync., pl. II., fig. 22). This specimen, which he states is a typical one, is in the Stockholm Museum. The specimen which I have examined lacks this marking, and it is presumably a variable character. The rostrum is more slender than that of any of our northern species, but is sufficiently stout to indicate predatory habits on the part of the species.

Distribution. — Colorado, Texas, Mexico, Guatemala.

PODISUS MUCRONATUS Uhler. (Plate 1, fig. 9.)

1897, *Podisus mucronatus* Uhler, Trans. Md. Acad. Sc., pp. 386, 387.

Length, 9 mm. Head rounded anteriorly, the lateral lobes not extending beyond tylus. General color testaceous, with dark-brown punctures arranged in longitudinal series. First segment of antennæ projecting slightly beyond the lateral margin of head; second segment pale amber colored, slender, two-thirds as long as head; third segment two-thirds as long as second, darkened toward apex; fourth and fifth segments of nearly equal length, pale brown, each three-fourths as long as second. Rostrum of medium size, reaching to hind coxæ. Pronotum ivory yellow, sparingly punctate with brown, and bordered on its anterior lateral margins with pale yellow. Humeral angles produced into slender dark-brown spines, which curve sharply toward the head. Scutellum ivory yellow, very sparsely punctate with brown, and with a large bald spot at the tip and a smaller bald spot in each basal angle. Corium sanguineous, thinly punctate with brown. Membrane dark bronze colored. Under-surface sulphur yellow, tinged laterally with reddish, with scattering pale-brown punctures anteriorly. Ventral spine slender, acute, reaching upon hind coxæ. Legs pale amber colored.

Distribution. — Florida, Cuba.

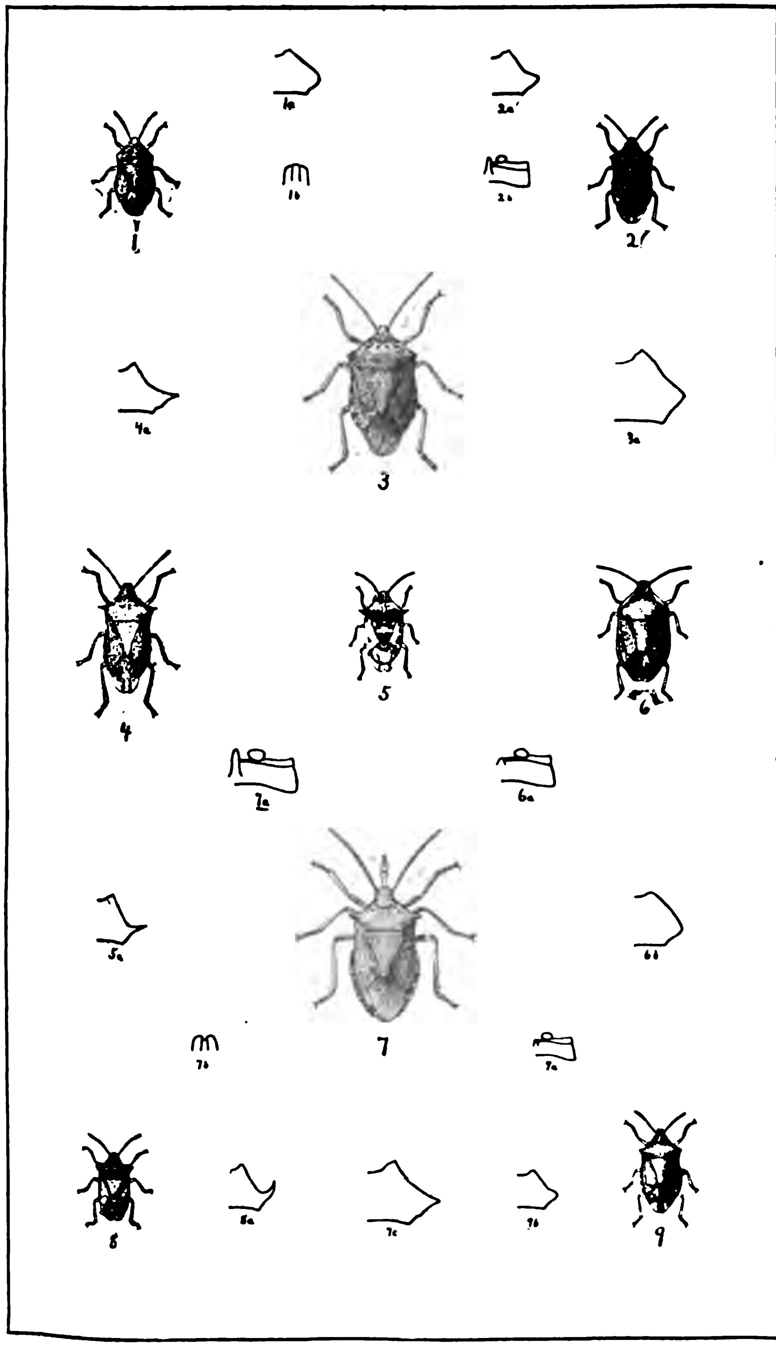
Prof. P. R. Uhler, to whom I am indebted for many favors in connection with the preparation of this paper, has very kindly given me an opportunity to examine this interesting species.

Explanation of Plate 1.

Figures of insects drawn by J. H. EMERTON; structural details by A. H. KIRKLAND.

Fig. 1. **Podisus placidus**, natural size.
Fig. 1*a*. **Podisus placidus**, right humeral angle enlarged.
Fig. 1*b*. **Podisus placidus**, anterior margin of head enlarged.
Fig. 2. **Podisus serieventris**, natural size.
Fig. 2*a*. **Podisus serieventris**, right humeral angle enlarged.
Fig. 2*b*. **Podisus serieventris**, ventral spine enlarged.
Fig. 3. **Podisus crocatus**, natural size.
Fig. 3*a*. **Podisus crocatus**, right humeral angle enlarged.
Fig. 4. **Podisus spinosus**, natural size.
Fig. 4*a*. **Podisus spinosus**, right humeral angle enlarged.
Fig. 5. **Podisus acutissimus**, natural size (from Distant).
Fig. 5*a*. **Podisus acutissimus**, right humeral angle enlarged.
Fig. 6. **Podisus gillettei**, natural size.
Fig. 6*a*. **Podisus gillettei**, ventral spine enlarged.
Fig. 6*b*. **Podisus gillettei**, right humeral angle enlarged.
Fig. 7. **Podisus cynicus**, natural size.
Fig. 7*a*. **Podisus cynicus**, ventral spine enlarged.
Fig. 7*b*. **Podisus cynicus**, anterior margin of head enlarged.
Fig. 7*c*. **Podisus cynicus**, right humeral angle enlarged.
Fig. 8. **Podisus mucronatus**, natural size.
Fig. 8*a*. **Podisus mucronatus**, right humeral angle enlarged.
Fig. 9. **Podisus modestus**, natural size.
Fig. 9*a*. **Podisus modestus**, ventral spine enlarged.
Fig. 9*b*. **Podisus modestus**, right humeral angle enlarged.

Plate 1.



ANNUAL REPORT

OF THE

BOARD OF CATTLE COMMISSIONERS,

IN ACCORDANCE WITH SECTION 51 OF CHAPTER 491
OF THE ACTS OF 1894.

JANUARY 11, 1898.

REPORT

OF THE

BOARD OF CATTLE COMMISSIONERS.

To the Honorable Senate and House of Representatives.

As provided for in section 51 of chapter 491 of the Acts of the year 1894, the Board of Cattle Commissioners hereby presents the following report of its work for the year 1897.

As was the case last year, the law of 1894 continued to be the basis of the work for the year 1897; and, as in 1896, the work has been continued under the following heads: —

First. — The supervision and direction of the work of the local inspectors appointed by the cities and towns under the provisions of chapter 491 of the Acts of 1894, and the examination of all animals quarantined by them as suspected of being afflicted with contagious disease.

Second. — The examination of cattle coming into the markets at Brighton, Watertown and Somerville from without the State for sale.

Third. — The examination and identification of cattle coming from without the State upon special permit.

Fourth. — The conduct of laboratory and stable experiments, to determine problems connected with the work of the Board.

Under section 1 of chapter 491 of the Acts of the year 1894, the mayor and aldermen of cities and the selectmen of towns must appoint one or more persons to be inspectors of animals and provisions. These inspectors must make regular and thorough inspection of all neat cattle, sheep and swine found within the limits of their several towns, when ordered to do so by the Board of Cattle Commissioners. They shall also make inspection of any domestic animal, whenever they have knowledge, or reason to believe, that such animal is affected with any contagious disease; and they shall also examine at the time of slaughter all neat cattle, sheep and swine slaughtered at slaughter houses licensed under the provision of this law.

The names of the inspectors appointed under this act are as follows: —

Abington,	John N. Chamberlain.
Acton,	Moses A. Reed.
Acushnet,	Philip A. Bradford.
Adams,	Andrew G. Potter.
Agawam,	Edwin Leonard.
Agawam,	Elijah D. Allen.
Alford,	Samuel K. Williams.
Amesbury,	Edward S. Worthen.
Amherst,	Henry E. Paige.
Andover,	Charles H Newton.
Arlington,	Alonzo S. Harriman.
Arlington,	Henry L. Alderman.
Ashburnham,	Charles W. Whitney, 2d.
Ashby,	Charles C. Damon.
Ashfield,	Walter G. Lesure.
Ashfield,	Homer S. Day.
Ashland,	Samuel D. Witt.
Ashland,	Edmund A. Stone.
Athol,	Oscar F. Stearns.
Attleborough,	Thomas L. Swift.*
Attleborough,	George Mackie.
Auburn,	Emory Stone.
Avon,	Charles E. May.
Ayer,	William H. Dudley.
Barnstable,	Alfred Crocker.
Barnstable,	John J. Harlow.
Barre,	John L. Smith.
Becket,	Lyman N. Cone.
Becket,	Edwin Lee.
Bedford,	Henry Wood.
Belchertown,	Guy C. Allen.
Bellingham,	Carroll E. White.
Belmont,	Benjamin A. Harris.
Berkley,	Eliphalet Terry.
Berlin,	Robert B. Wheeler.
Bernardston,	Charles Bowker.
Beverly,	Horace D. Lambert.
Billerica,	William H. Hutchins.
Blackstone,	Daniel H. Cooney.
Blackstone,	Elias M. Billings.
Blandford,	George Cadwell.
Blandford,	E. B. Gibbs.
Blandford,	Frank J. Candee.
Bolton,	Henry F. Haynes.

* Removed.

Boston,	Alexander Burr.
Boston,	J. C. Grouse.
Boston,	T. F. Kelley.
Boston,	George W. Roberts.
Bourne,	Noble P. Swift.
Boxborough,	Philip W. Cunningham.
Boxford,	Charles A. Andrew.
Boxford,	George B. Killam.
Boylston,	Luther S. Hapgood.
Braintree,	James M. Cutting.
Brewster,	Henry E. Baker.
Bridgewater,	Calvin Pratt.
Brimfield,	Porter A. Parker.
Brockton,	Simeon Mitchell.
Brockton,	Lucas W. Alden.
Brookfield,	George Allen.
Brookline,	Frederick H. Osgood.
Buckland,	Henry L. Warfield.
Burlington,	James N. Stuart.
Cambridge,	Charles E. Hadcock.
Canton,	Patrick J. Cronon.
Carlisle,	George P. Davis.
Carver,	Benjamin W. Robbins.
Charlemont,	William B. Avery.
Charlemont,	Horace Temple.
Charlton,	Stephen Hammond.
Chatham,	Isaac B. Young.
Chelmsford,	Edwin C. Perham.
Chelsea,	William Stinson.
Cheshire,	William P. Bennett.
Chester,	Daniel B. Holcomb.
Chester,	Edward L. Higgins.
Chesterfield,	George W. Rogers.
Chesterfield,	Clayton N. Rhoades.
Chicopee,	Thomas Goodwin.
Chicopee,	Irving H. Elmer.
Chilmark,	Freeman Hancock.
Clarksburg,	James Mixer.
Clinton,	Eugene H. Lehnert.
Cohasset,	Caleb F. Nichols.
Colrain,	C. Webster Smith.
Colrain,	H. Spencer Meacham.
Concord,	Horace Tuttle.
Conway,	Gordon H. Johnson.
Cottage City,	Edmund G. Beetle.
Cummington,	Edward F. Warner.
Cummington,	Myron D. Trow.
Cummington,	Finley V. Bates.
Dalton,	William Miller.

Dalton, ...	William C. Brague.
Dana, ...	Alfred W. Doane.
Danvers, ...	Charles S. Moore.
Dartmouth, ...	Charles W. Howland.
Dartmouth, ...	Charles H. Negus.
Dedham, ...	Edward Knobel, Jr.
Deerfield, ...	Dwight A. Hawks.
Deerfield, ...	Edward D. Jewett.
Dennis, ...	Edwin Whittemore.
Dennis, ...	Charles E. Baker.
Dighton, ...	Nathan O. Walker.
Dighton, ...	William H. Walker.
Dighton, ...	George A. Clark.
Douglas, ...	Edwin P. Heath.
Douglas, ...	James Dermody.
Dover, ...	James McGill.
Dracut, ...	William S. Eaton.
Dudley, ...	Monroe W. Ide.
Dunstable, ...	Franklin N. Tolles.
Duxbury, ...	George Bradford.
Duxbury, ...	John K. Parker.
East Bridgewater, . . .	William T. Green.
East Longmeadow, . . .	Edwin Indicott.
Eastham, ...	Reuben H. Horton.
Easthampton, ...	Fordyce Whitmarsh.
Easton, ...	Edward R. Hayward.
Edgartown, ...	Christopher R. Beetle.
Egremont, ...	William F. Crippen.
Enfield, ...	Albert R. House.
Enfield, ...	William H. Bush.
Erving, ...	Frank W. Loveland.
Essex, ...	C. Amos Burnham.
Essex, ...	Edward F. Knowlton.
Everett, ...	William Stinson
Fairhaven, ...	Ebenezer G. Grinnell.
Fall River, ...	Hilaire Bisaillon.
Falmouth, ...	Barzillai C. Cahoon.
Falmouth, ...	Herbert H. Lawrence.
Fitchburg, ...	Otis F. Lord.
Florida, ...	Nathan W. Kemp.
Foxborough, ...	A. W. Draper.
Foxborough, ...	F. G. Lillyman.
Framingham, ...	Joseph G. E. Page.
Franklin, ...	William F. King.
Freetown, ...	Palo Alto Pierce.
Freetown, ...	James Webb.
Freetown, ...	Charles H. Read.
Gardner, ...	Augustus S. Cleaves.
Gardner, ...	Frank B. Page.

Gay Head,	Samuel J. Hasking.
Georgetown,	Samuel T. Poor.
Georgetown,	J. Winfred Yeaton.
Gill,	John L. S. Moore.
Gloucester,	Daniel G. Cressy.
Goshen,	Willis A. Smith.
Gosnold,	Josiah W. Tilton.
Grafton,	Perley Goddard.
Granby,	George L. Witt.
Granby,	C. D. Lyman.
Granville,	George W. Cone.
Granville,	Joseph Welch.
Great Barrington,	Edwin Hurlburt.
Great Barrington,	George H. Cobb.
Greenfield,	Mark L. Miner.
Greenwich,	Walter H. Glazier.
Groton,	Solon R. Dodge.
Groveland,	Thomas E. Snell.
Hadley,	Charles H. Hunt.
Hadley,	Homer L. Cowles.
Halifax,	Jabez P. Thompson.
Hamilton,	George E. F. Dane.
Hampden,	Moses H. Warren.
Hancock,	James S. Goold.
Hanover,	Edwin B. Dwelley.
Hanson,	Ezra White.
Hardwick,	John N. Hillman.
Harvard,	Mark A. Farnsworth.
Harwich,	John A. Baker.
Hatfield,	E. S. Warner.
Haverhill,	Grantley Bickell.
Haverhill,	Doane Cogswell.
Hawley,	L. W. Temple.
Heath,	V. D. Thompson.
Hingham,	Robert F. Robinson.
Hinsdale,	Frank C. Phillips.
Holbrook,	Z. P. Jordan.
Holden,	E. W. Merrick.
Holden,	W. A. Jordan.
Holden,	Allen Brown.
Holden,	Alvin Thurston.
Holland,	A J. Bagley.
Holliston,	Isaac A Smith.
Holyoke,	Bernard F. Bigelow.
Hopedale,	Waldo Phipps.
Hopkinton,	Winslow W. Claflin.
Hubbardston,	John H. Burtch.
Hudson,	A. L. Cundall.

Hull, ...	Harvey T. Litchfield.*
Hull, ...	Darius W. Gilbert.
Huntington, ...	Heman Burr.
Huntington, ...	Fred W. Lyman.
Hyde Park, ...	Joseph M. Kiggen.
Ipswich, ...	Daniel S. Appleton.
Kingston, ...	E. Elbridge Atwood.
Lakeville, ...	Isaac Sampson
Lancaster, ...	Henry F. Hosmer.
Lancaster, ...	A. W. Carr.
Lanesborough, ...	William P. Talcott.
Lawrence, ...	John F. Winchester.
Lawrence, ...	Valentine T. Sellers.
Lee, ...	John H. McAllister.
Leicester, ...	Henry B. Watts.
Lenox, ...	Charles C. Flint.
Leominster, ...	George M. Kendall.
Leverett, ...	O. C. Marvell.
Lexington, ...	Charles M. Parker.
Leyden, ...	Ezra Foster.*
Leyden, ...	Albert J. Shattuck.
Lincoln, ...	Roger Sherman.
Littleton, ...	Joseph N. Murray.
Longmeadow, ...	Spencer W. Gates.
Lowell, ...	Walter A. Sherman.
Ludlow, ...	Adelbert L. Bennett.
Lunenburg, ...	Charles E. Woods.
Lunenburg, ...	Micah M. Boutwell.
Lynn, ...	William E. Welts.
Lynnfield, ...	William R. Roundy.
Malden, ...	James H. Kimball.
Manchester, ...	John Riordan.
Mansfield, ...	Joseph N. Tebbetts.
Marblehead, ...	Benjamin F. Martin, Jr.
Marion, ...	George F. Richards.
Marlborough, ...	Patrick J. Mahoney.
Marshfield, ...	Franklin W. Hatch.
Mashpee, ...	Darius Coombs.
Mattapoisett, ...	David H. Cannon.
Maynard, ...	Joel F. Parmenter.
Medfield, ...	Francis D. Hamant.
Medford, ...	Henry F. Moore.
Medway, ...	Edward Whiting.
Melrose, ...	F. P. Sturges.
Mendon, ...	Albert W. Gaskill.
Merrimac, ...	Charles A. Wallace.
Methuen, ...	Edwin J. Castle.

* Deceased.

Middleborough, ...	James A. Burgess.
Middlefield, ...	John T. Bryan.
Middleton, ...	Andrew W. Peabody.
Milford, ...	Waldo Phipps.
Millbury, ...	Henry W. Carter.
Millis, ...	Moses C. Adams.
Milton, ...	James Spencer.
Monroe, ...	A. H. Goldthwait.
Monson, ...	William H. Bugbee.
Monson, ...	Hiram D. Osborne.
Montague, ...	G. H. Goddard.
Montague, ...	F. H. Giles.
Monterey, ...	Lewis H. Mallory.
Montgomery, ...	Willis B. Cushman.
Mount Washington, . . .	Alfred I. Spurr.
Nahant, ...	Robert L. Cochran.
Nantucket, ...	Albert Easton.
Natick, ...	Walter P. Mayo.
Needham, ...	Samuel O. Fowle.
New Ashford, ...	Van Ness Mallery.
New Bedford, ...	Daniel C. Ashley.
New Braintree, ...	Charles A. Felton.
New Marlborough, . . .	George A. Stevens.
New Marlborough, . . .	Lorin P. Keyes.
New Salem, ...	Willard Putnam.
Newbury, ...	Asa Pingree.
Newburyport, ...	George W. Knight.
Newton, ...	James R. McLaughlin.
Norfolk, ...	Andrew R. Jones.
North Adams, ...	Angus A. McDonnel.
North Andover, ...	George S. Fuller.
North Attleborough, . . .	W. Henry Kling.
North Attleborough, . . .	G. B. Draper.
North Attleborough, . . .	Asa A. Newell.
North Brookfield, . . .	B. F. Barnes.
North Brookfield, . . .	Alfred O. Boyd.
North Reading, ...	F. Howard Mosman.
Northampton, ...	John H. Roberts.
Northborough, ...	Allyn D. Phelps.
Northbridge, ...	George F. Nilsson.
Northbridge, ...	R. H. Baton.
Northbridge, ...	W. A. Beane.
Northbridge, ...	John Lincoln.
Northfield, ...	R. C. Ward.
Norton, ...	Oren E. Walker.
Norton, ...	Lester D. Blandin.
Norwell, ...	J. Warren Foster.
Norwell, ...	Edwin C. Briggs.
Norwell, ...	Ashburton W. Pinson.

Norwood, ...	Albert Fales.
Oakham, ...	Henry P. Austin.
Orange, ...	Amos Blodgett.
Orleans, ...	Edmund Linnell.
Otis, ...	Edwin L. Downs.
Otis, ...	Alfred D. Jones.
Oxford, ...	Fred L. Snow.
Oxford, ...	Willis Rosebrooks.
Palmer, ...	Charles F. Smith.
Palmer, ...	E. W. Phinney.
Paxton, ...	Hiram P. Bemis.
Peabody, ...	Charles Davis.
Peabody, ...	Cyrus T. Batchelder.
Peabody, ...	John E. Herrick.
Pelham, ...	John A. Page.
Pembroke, ...	Clifford I. Rogers.
Pepperell, ...	Samuel P. Bancroft.
Peru, ...	Henry Barlow.
Petersham, ...	S. C. Goddard.
Phillipston, ...	Robert E. McLane.
Pittsfield, ...	George N. Kinnell.
Plainfield, ...	Daniel H. Gould.
Plainfield, ...	Edwin A. Atkins.
Plymouth, ...	Clark Finney, Jr.
Plympton, ...	Howard O. Bonney.
Prescott, ...	Elmer M. Aiken.
Prescott, ...	James D. Barnes.
Prescott, ...	Mason W. Haskins.
Princeton, ...	George Mason, Jr.
Provincetown, ...	Daniel F. Lewis.
Quincy, ...	Charles H. Johnson.
Randolph, ...	Augustus L. Chase.
Raynham, ...	Cyrus Leonard, 2d.
Reading, ...	Milton D. Parker.
Rehoboth, ...	Clarence J. Kingsbury.
Rehoboth, ...	Albert R. Lewis.
Rehoboth, ...	John W. Chase.
Revere, ...	Edwin S. Plaisted.
Richmond, ...	W. H. Branch.
Rochester, ...	Allen G. Ashley.
Rockland, ...	Charles Winslow.
Rockport, ...	Alvin Sanborn.
Rowe, ...	E. M. Upton.
Rowley, ...	Daniel H. Hale.
Rowley, ...	J. Scott Todd.
Royalston, ...	George E Peirce.
Russell, ...	Sidney S Shurtleff.
Rutland, ...	F. G. Bartlett.
Salem, ...	Fred Saunders.

Salisbury, ...	N. T. Getchell.
Sandisfield, ...	Henry S. Manley.
Sandisfield, ...	Charles H. Callender.
Sandisfield, ...	Hiram Bliss.
Sandwich, ...	Samuel H. Nye.
Saugus, ...	A. W. Sawyer.
Savoy, ...	L. E. Perry.
Savoy, ...	Milton A. Bliss.
Scituate, ...	Caleb L. Damon.
Seekonk, ...	Lowell M. Cole.
Seekonk, ...	Robert Woodward.
Seekonk, ...	Olney Greene.
Sharon, ...	A. W. Draper.
Sharon, ...	George Richards.
Sheffield, ...	Henry Clark.
Sheffield, ...	Edwin L. Boardman.
Shelburne, ...	William M. Bardwell.
Shelburne, ...	B. F. Maxwell.
Shelburne, ...	T. R. Shearer.
Sherborn, ...	Jasper J. Smart.
Shirley, ...	Samuel B. Scott.
Shrewsbury, ...	David Barnes.
Shutesbury, ...	Oscar H. Shaw.
Somerset, ...	Thomas A. Francis.
Somerville, ...	Charles M. Berry.
South Hadley, ...	Horace W. Gaylord.
Southampton, ...	Henry E. Coleman.
Southampton, ...	Michael Norris.
Southborough, ...	William H. Buck.
Southbridge, ...	Henry A. Morse.
Southbridge, ...	Francis H. Olin.
Southwick, ...	Charles W. Talmadge.
Spencer, ...	Ahraham Capen.
Springfield, ...	James Kimball.
Sterling, ...	William S. Walker.
Stockbridge, ...	John M. Buck.
Stockbridge, ...	Marshall S. Heath.
Stoneham, ...	George H. Allen.
Stoughton, ...	James Murphy.
Stow, ...	Lewis Parks.
Sturbridge, ...	William Whittemore.
Sudbury, ...	George A. Haynes.
Sudbury, ...	Hiram Haynes.
Sunderland, ...	George P. Smith.
Sutton, ...	Edward A. Welch.*
Sutton, ...	P. D. King.
Swampscott, ...	Samuel A. Spaulding.†
Swampscott, ...	George Newhall.

* Deceased. † Resigned.

Swanzey, ...	Arthur W. Weaver.
Swanzey, ...	David B. Gardner.
Swanzey, ...	Anson L. Barney.
Taunton, ...	Walter H. Haskell.
Templeton, ...	S. E. Greenwood.
Templeton, ...	W. F. Robie.
Tewksbury, ...	George W. Trull.
Tisbury, ...	Henry C. Norton.
Tolland, ...	Oliver E. Slocum, Jr.
Topsfield, ...	E. L. Wildes.
Topsfield, ...	Benjamin A. Orne.
Townsend, ...	John N. Going.
Truro, ...	John G. Thompson.
Tyngsborough, ...	Henry J. Keyes.
Tyringham, ...	Joseph Jones.
Upton, ...	Benjamin A. Jourdan.
Upton, ...	George D. Whitney.
Uxbridge, ...	Charles E. Seagraves.
Wakefield, ...	Henry C. Perry.
Wales, ...	Warren W. Eager.
Walpole, ...	George S. Fuller.*
Walpole, ...	Isaac Miller.
Waltham, ...	William E. Peterson.
Ware, ...	A. A. Etienne.
Wareham, ...	Prince H. Swift.
Warren, ...	Marcus Burroughs.
Warwick, ...	Gilbert Maynard.
Washington, ...	Charles E. Shultz.
Watertown, ...	George W. Pope.
Wayland, ...	Thomas Bryant.
Webster, ...	George F. Hart.
Wellesley, ...	Samuel O. Fowle.
Wellfleet, ...	George W. Nickerson.
Wendell, ...	G. A. Lewis.
Wenham, ...	Henry Alley.
West Boylston, ...	John F. Knights.
West Bridgewater, ...	David R. Simmons.
West Brookfield, ...	Charles E. Smith.
West Newbury, ...	Alfred L. Moore.
West Springfield, ...	Henry A. Sibley.
West Springfield, ...	Ethan Brooks.†
West Springfield, ...	M. H. Bidwell.
West Stockbridge, ...	Ralph R. Bissell.
West Tisbury, ...	William B. Luce.
Westborough, ...	Henry A. Gilmore.
Westfield, ...	Michael F. Hoar.
Westford, ...	George T. Day.
Westford, ...	Albert P. Richardson.

* Deceased. † Declined.

Westhampton, ...	William J. Lyman.
Westhampton, ...	A. D. Montague, Jr.
Westminster, ...	M. D. Whitney.
Westminster, ...	Edward P. Miller.
Weston, ...	Gilbert W. Blood.
Weston, ...	Everett O. Clark.
Westport, ...	Edward S. Smith.
Westport, ...	Theodore B. Pierce.
Westwood, ...	Creighton Colburn.
Weymouth, ...	Hiram E. Raymond.
Weymouth, ...	Charles E. Bicknell.
Whately, ...	Irving Allis.
Whitman, ...	Owen F. Bumpus.
Wilbraham, ...	Lyman A. Fisk.
Williamsburg, ...	George W. Lawley.*
Williamsburg, ...	Hallock H. Nichols.
Williamstown, ...	Joseph B. Hill.
Wilmington, ...	H. Allen Sheldon.
Winchendon, ...	William A. Deland.
Winchester, ...	William B. Simonds.
Windsor, ...	Gardner L. Miner.
Windsor, ...	H. Ward Ford.
Winthrop, ...	John McNaught.
Woburn, ...	James N. Stuart.
Worcester, ...	J. Warren Ellsworth.
Worcester, ...	Thomas Monahan.
Worcester, ...	John P. Streeter.
Worthington, ...	Horace F. Bartlett.
Wrentham, ...	Elisha M. Brastow.
Wrentham, ...	George B. Ware.
Yarmouth, ...	Isaiah Homer.
Yarmouth, ...	James Lack.
Yarmouth, ...	Isaiah Crowell.

It had previously been the custom of the Board to order the inspectors to make the regular inspection in the fall of the year. This had been found unsatisfactory, as in a great many instances it is the custom for the owners to leave their cattle out until late in the fall, and it frequently happened that at the time of the inspection all the animals had not been taken up from pasture. Because of this, the Board did not think it possible that the work could be done by the inspectors without passing over many animals; but, as the Legislature did not grant the appropriation until late in the season, it had been found impossible to make a change.

* Resigned.

During the past year, however, the Board was granted the appropriation much earlier, and in consequence of this they were enabled to change the time of inspection from fall to spring. As a result of this change they were able to make a more thorough inspection at a time when such animals as were affected would be apt to show the effects of their winter's confinement, and when it was also possible to find them all on the owner's premises. Consequently, on March 9 the following letter was sent to each inspector, instructing him to make an immediate general inspection of the animals within the limits of his district: —

COMMONWEALTH OF MASSACHUSETTS.

BOARD OF CATTLE COMMISSIONERS,
COMMONWEALTH BUILDING, BOSTON, March 9, 1897.

DEAR SIR: — Section 4, chapter 491 of the Acts of 1894, as amended by section 1, chapter 496 of the Acts of 1895, provides that "inspectors shall make regular and thorough inspections of all neat cattle, sheep and swine found within the limits of their several cities and towns. Such inspection shall be made at such times and in such manner as the Board of Cattle Commissioners shall from time to time determine and direct." This section also provides that "inspectors shall immediately inspect all domestic animals, and any barn, stable or premises where such animals are kept, whenever directed to do so by the Board of Cattle Commissioners."

Believing that a complete general inspection made at this time would be more satisfactory than one made in the fall, when many animals might be still in pasture, and in accordance with the above authority conferred on us, the Board of Cattle Commissioners hereby order an immediate inspection of all neat cattle, sheep and swine, and all barns, stables and premises where such animals are kept in their several districts. Such inspection is to begin at this date and to be carried on with all possible despatch until finished, or until the first day of May, 1897, when such inspection is hereby ordered closed. The returns of this inspection will be made on the blank form provided, and such returns must be sent to this office each week until completed.

It is further recommended that inspectors ascertain the whereabouts of a number of cattle which they think should be quarantined, and then serve a number of quarantine orders on one day, so as to send us several quarantines at one time, rather than one

or two a day, extended over a period of two or three weeks, as it is much less expensive to send an agent to test a number of animals at one time than it is to send the same agent a number of times to test the same lot of animals.

We also call the notice of inspectors to the regulations for cleansing and disinfecting, which they must see are strictly carried out by the owners or occupants of all premises from which cattle are removed by order of the Board of Cattle Commissioners.

Specimens to be examined, dogs to be tested for the diagnosis of rabies, and the like, are hereafter to be sent by express to Dr. Langdon Frothingham, Harvard Medical School, 688 Boylston Street, Boston, Mass. In every case the name and address of the owner of the animal, with the history of the case, should be enclosed with the specimen.

Yours truly, AUSTIN PETERS, *Chairman.*

The work of the inspectors having been ordered completed by May 1, the following letter, dated May 12, was sent to those inspectors who had not brought their work to a close:—

COMMONWEALTH OF MASSACHUSETTS.

BOARD OF CATTLE COMMISSIONERS,
BOSTON, MASS., May 12, 1897.

To the Town Inspector of Cattle.

SIR:—We desire to call your attention to our letter of March 9, ordering an inspection of cattle to be completed May 1.

In towns where the inspection was completed on this date, we wish to thank the inspectors for their promptness; where such inspection is not completed, we wish it brought to a close without further delay. No more cattle are to be quarantined until another inspection is ordered, unless some one reports a badly diseased creature to the Board of Health.

The inspectors of border towns are also requested to bear in mind the provisions of General Order No. 9, requiring that cattle brought in from without the State, which have not already been tested with tuberculin in a manner satisfactory to the Board of Cattle Commissioners, are to be held in quarantine at the expense of the owner until tested with tuberculin at his expense by a veterinarian acceptable to this Board.

Per order Massachusetts Board of Cattle Commissioners,
AUSTIN PETERS, *Chairman.*

This letter was sent out for the purpose of stopping the *general inspection;* but, while it was intended to close this

inspection, it was of course still possible for the inspector to quarantine such animals as were reported in writing as diseased to the local board of health, and this class of work has gone on all summer.

The following table gives the number of cattle assessed in each town, the total number of cattle tested, and the number condemned and paid for during the year, as well as the State tax for each town in the Commonwealth: —

CITY OR TOWN.	Neat Cattle Assessed.	Number Tested.	Number Paid for.	Amount Paid.	State Tax.
Abington,	254	14	5	$153 00	$1,750 00
Acton,	1,175	144	127	4,751 50	1,050 00
Acushnet,	449	9	3	75 00	437 50
Adams,	689	18	2	75 00	2,695 00
Agawam,	2,315	17	17	395 00	945 00
Alford,	275	7	4	125 00	157 50
Amesbury,	381	39	25	727 50	3,657 50
Amherst,	1,696	34	18	431 25	2,222 50
Andover,	913	87	50	1,980 00	3,430 00
Arlington,	257	12	-	-	5,653 00
Ashburnham,	431	34	25	764 75	752 50
Ashfield,	1,269	7	5	190 00	367 50
Ashby,	570	60	36	1,128 00	367 50
Ashland,	309	23	16	516 50	857 50
Athol,	514	16	5	205 00	2,642 50
Attleborough,	776	36	24	654 00	3,220 00
Avon,	109	1	-	-	542 50
Ayer,	113	1	1	7 00	962 50
Auburn,	826	1	2	60 00	402 50
Barnstable,	584	4	2	13 00	2,695 00
Barre,	1,995	58	30	924 50	1,032 50
Becket,	642	-	-	-	332 50
Bedford,	627	21	17	495 00	682 50
Belchertown,	1,959	18	9	227 00	630 00
Bellingham,	524	37	19	584 50	490 00
Belmont,	215	7	2	38 00	2,642 50
Berkley,	403	-	-	-	315 00
Berlin,	555	9	5	137 50	350 00
Bernardston,	797	15	10	287 50	297 50
Beverly,	595	4	2	50 00	10,132 50
Billerica,	809	195	133	5,677 51	1,382 50
Blackstone,	351	-	-	-	1,890 00
Blandford,	955	26	9	243 00	312 00
Bolton,	758	54	46	1,353 00	332 50
Boston,	400	288	98	3,557 99	628,740 00
Bourne,	174	-	-	-	172 50
Boxborough,	532	52	42	1,418 00	157 50
Boylston,	741	6	3	75 00	350 00
Boxford,	555	19	16	457 50	437 50
Braintree,	404	-	-	-	3,115 00
Brewster,	188	-	-	-	437 50
Bridgewater,	464	10	4	185 00	1,767 50
Brimfield,	1,033	24	20	581 50	297 50
Brockton,	696	55	29	1,012 25	15,085 00
Brookfield,	803	1	1	5 00	1,050 00
Brookline,	361	5	3	115 00	41,632 50
Buckland,	736	2	2	55 00	420 00
Burlington,	478	8	6	210 00	350 00
Cambridge,	262	1	1	30 00	54,600 00

CITY OR TOWN.	Neat Cattle Assessed.	Number Tested.	Number Paid for.	Amount Paid.	State Tax.
Canton, ...	374	9	7	$267 00	$3,027 50
Carlisle, ...	513	326	195	3,700 00	245 00
Carver, ...	164	-	-	-	577 00
Charlemont, . . .	732	13	4	73 50	280 00
Charlton, ...	1,595	30	24	682 00	682 50
Chatham, ...	177	-	-	-	665 00
Chelmsford, . . .	1,100	209	136	4,769 00	1,452 50
Chelsea, ...	82	2	-	-	15,802 50
Cheshire, ...	998	4	2	27 00	525 00
Chester, ...	650	1	1	20 00	455 00
Chesterfield, . . .	696	18	8	269 00	210 00
Chicopee, ...	594	16	10	312 00	5,810 00
Chilmark, ...	152	-	-	-	157 50
Clarksburg, ...	355	-	-	-	175 00
Clinton, ...	150	-	-	-	4,865 00
Cohasset, ...	297	-	-	-	3,360 00
Colrain, ...	1,317	49	7	163 00	420 00
Concord, ...	1,428	129	98	3,170 00	2,940 00
Conway, ...	1,293	79	48	1,426 00	507 50
Cottage City, . . .	111	-	-	-	980 00
Cummington, . . .	645	47	26	894 50	227 50
Dalton, ...	448	11	2	75 00	2,047 50
Dana, ...	250	1	-	-	210 00
Danvers, ...	745	27	23	922 00	3,150 00
Dartmouth, ...	1,752	3	3	60 00	1,890 00
Dedham, ...	486	42	25	722 50	4,602 50
Deerfield, ...	1,231	78	29	882 00	1,155 00
Dennis, ...	198	-	-	-	1,172 50
Dighton, ...	360	5	4	95 00	595 00
Douglas, ...	334	4	1	20 00	735 00
Dover, ...	622	21	12	350 00	682 00
Dracut, ...	950	163	155	5,899 00	1,172 50
Dudley, ...	906	15	12	276 00	787 50
Dunstable, ...	661	13	7	190 50	210 00
Duxbury, ...	290	8	1	15 00	1,102 50
East Bridgewater, .	531	19	8	212 00	1,155 00
East Longmeadow, .	525	6	3	63 00	490 00
Eastham, ...	181	-	-	-	210 00
Easthampton, . . .	741	9	5	132 50	1,750 00
Easton, ...	659	7	4	90 00	3,552 50
Edgartown, ...	324	-	-	-	525 00
Egremont, ...	851	14	7	244 00	332 50
Enfield, ...	514	1	-	-	560 00
Erving, ...	170	-	-	-	280 00
Essex, ...	487	-	-	-	700 00
Everett, ...	133	8	-	-	8,610 00
Fairhaven, ...	440	-	-	-	1,382 50
Fall River, ...	591	14	4	62 50	43,540 00
Falmouth, ...	422	3	-	-	4,287 50
Fitchburg, ...	761	32	24	800 00	13,860 00
Florida, ...	358	-	-	-	122 50
Foxborough, . . .	361	14	4	85 00	1,190 00
Framingham, . . .	1,056	60	36	1,387 00	6,527 50
Franklin, ...	701	40	21	549 00	2,100 00
Freetown, ...	591	4	-	-	630 00
Gardner, ...	461	212	86	3,221 50	3,552 50
Gay Head, ...	56	-	-	-	17 50
Georgetown, . . .	276	-	-	-	752 50
Gill, ...	678	35	12	374 00	332 50
Gloucester, ...	550	2	-	-	11,375 00
Goshen, ...	382	3	1	23 00	105 00
Gosnold, ...	51	-	-	-	140 00
Grafton, ...	1,118	79	34	1,134 50	1,732 50
Granby, ...	1,296	63	41	1,031 50	332 50
Granville, ...	661	15	-	-	262 50
Great Barrington, .	1,517	10	5	115 00	2,572 50
Greenfield, . . .	1,064	108	61	2,102 50	3,727 50

CITY OR TOWN.	Neat Cattle Assessed.	Number Tested.	Number Paid for.	Amount Paid.	State Tax.
Greenwich,	341	12	6	$173 00	$192 50
Groton,	993	45	33	1,068 50	2,047 50
Groveland,	226	2	1	40 00	700 00
Hadley,	1,484	18	9	178 00	735 00
Halifax,	149	1	1	15 00	192 50
Hamilton,	372	1	-	-	752 50
Hampden,	601	11	3	75 00	280 00
Hancock,	604	8	2	60 00	245 00
Hanover,	286	3	-	-	1,015 00
Hanson,	164	2	1	39 00	455 00
Hardwick,	1,887	86	40	1,159 00	1,085 00
Harvard,	1,316	105	66	2,228 50	717 50
Harwich,	189	-	-	-	875 00
Hatfield,	439	3	2	43 00	735 00
Haverhill,	894	76	42	1,374 00	14,735 00
Hawley,	576	-	1	22 50	122 50
Heath,	722	25	9	234 00	140 00
Hingham,	506	1	-	-	3,167 50
Hinsdale,	695	-	-	-	542 50
Holden,	694	-	-	-	845 00
Holbrook,	147	-	-	-	945 00
Holland,	131	14	9	233 50	70 00
Holliston,	708	7	5	164 00	1,207 50
Holyoke,	602	18	5	155 00	19,040 00
Hopedale,	106	10	4	152 00	1,820 00
Hopkinton,	735	51	31	1,107 50	1,470 00
Hubbardston,	933	32	19	609 50	490 00
Hudson,	735	14	8	330 00	2,082 50
Hull,	79	1	1	40 00	1,820 00
Huntington,	517	21	4	122 50	385 00
Hyde Park,	116	6	2	55 00	5,932 50
Ipswich,	935	6	9	202 00	2,065 00
Kingston,	205	5	2	38 00	1,172 50
Lakeville,	376	7	4	98 00	402 50
Lancaster,	622	41	24	816 00	2,082 50
Lanesborough,	870	48	41	1,320 00	367 50
Lawrence,	169	20	13	535 00	23,240 00
Lee,	721	90	3	70 00	1,295 00
Leicester,	536	3	3	80 00	1,645 00
Lenox,	638	39	20	600 00	2,082 50
Leominster,	723	96	69	2,431 00	3,990 00
Leverett,	455	1	-	-	210 00
Lexington,	1,044	119	106	4,067 50	2,052 50
Leyden,	470	36	7	204 64	122 50
Lincoln,	775	123	95	3,599 00	1,610 00
Littleton,	1,223	70	35	1,217 00	612 50
Longmeadow,	281	21	18	494 00	437 50
Lowell,	280	43	32	1,448 50	49,000 00
Ludlow,	1,039	30	18	493 00	752 50
Lunenburg,	633	54	31	847 00	560 00
Lynn,	227	53	4	117 00	34,667 00
Lynnfield,	287	18	1	8 00	420 00
Malden,	161	-	-	-	17,307 00
Manchester,	86	-	-	-	4,970 00
Mansfield,	226	5	-	-	1,277 50
Marblehead,	294	4	3	73 00	4,042 50
Marion,	116	-	-	-	577 50
Marlborough,	841	17	15	652 00	5,792 50
Marshfield,	530	38	14	420 50	945 00
Mashpee,	36	-	-	-	122 50
Mattapoisett,	225	2	2	45 00	1,050 00
Maynard,	229	106	102	3,987 50	1,470 00
Medfield,	508	2	2	95 00	997 50
Medford,	303	1	2	45 00	10,902 50
Medway,	435	9	6	175 00	927 50
Melrose,	222	1	1	40 00	6,877 50
Mendon,	567	12	8	161 00	385 00

CITY OR TOWN.	Neat Cattle Assessed	Number Tested.	Number Paid for.	Amount Paid.	State Tax.
Merrimac, ...	281	6	2	$25 00	$945 00
Methuen, ...	1,347	67	40	1,311 00	2,467 50
Middleborough, . .	664	15	11	375 00	2,975 00
Middlefield, . . .	469	1	–	–	175 00
Middleton, . . .	246	12	6	133 00	367 50
Milford, ...	405	5	2	75 00	3,867 50
Millbury, ...	730	15	10	289 50	1,680 00
Millis, ...	509	3	3	100 00	595 00
Milton, ...	871	4	2	27 00	13,737 50
Monroe, ...	155	–	–	–	105 00
Monson, ...	1,280	13	7	180 00	1,400 00
Montague, ...	777	59	7	232 50	2,555 00
Monterey, ...	536	2	–	–	175 00
Montgomery, . . .	356	–	–	–	105 00
Mount Washington, .	78	–	–	–	52 50
Nahant, ...	44	–	–	–	4,042 50
Nantucket, ...	512	–	–	–	2,117 50
Natick, ...	498	56	45	1,726 50	3,990 00
Needham, ...	638	9	6	172 75	1,977 50
New Ashford, . .	134	–	–	–	52 50
New Bedford, . .	581	2	1	50 00	36,067 50
New Braintree, . .	1,315	17	9	162 00	297 50
New Marlborough, .	134	17	5	104 00	402 50
New Salem, . . .	369	4	2	45 50	227 50
Newbury, ...	1,078	1	1	30 00	752 50
Newburyport, . . .	249	43	43	1,378 00	7,857 50
Newton, ...	1,176	510	35	1,189 00	32,077 50
Norfolk, ...	344	32	21	795 00	367 50
North Adams, . .	1,611	–	–	–	5,477 50
North Andover, . .	1,286	119	89	3,289 00	2,363 50
North Attleborough, .	591	30	24	692 50	2,800 00
North Brookfield, .	954	20	10	256 50	1,400 00
North Reading, . .	293	32	23	815 00	367 50
Northampton, . .	966	49	8	228 49	7,315 00
Northborough, . .	803	61	28	745 00	892 50
Northbridge, . . .	495	12	4	98 00	2,537 50
Northfield, . . .	1,056	2	–	–	682 50
Norton, ...	352	3	1	40 00	577 50
Norwell, ...	255	5	4	70 00	670 00
Norwood, ...	372	15	10	367 00	2,152 50
Oakham, ...	641	16	10	231 50	245 00
Orange, ...	795	35	19	546 00	2,817 50
Orleans, ...	168	1	–	–	490 00
Otis, ...	604	–	–	–	157 50
Oxford, ...	569	9	4	105 00	927 50
Palmer, ...	789	12	8	235 00	2,030 00
Paxton, ...	396	6	5	70 50	192 50
Peabody, ...	658	52	26	1,185 00	5,477 50
Pelham, ...	215	2	1	25 00	122 50
Pembroke, . . .	166	8	1	18 00	472 50
Pepperell, ...	813	83	19	559 00	1,435 00
Peru, ...	353	10	1	25 00	87 50
Petersham, . . .	612	31	10	267 50	455 00
Phillipston, . . .	351	35	6	127 00	210 00
Pittsfield, ...	1,155	49	10	322 00	9,415 00
Plainfield, ...	565	3	2	47 00	122 50
Plymouth, ...	401	12	6	157 50	4,620 00
Plympton, ...	109	–	–	–	227 50
Prescott, ...	399	3	2	17 50	122 50
Princeton, ...	1,240	155	85	2,953 00	577 50
Provincetown, . .	61	–	–	–	1,592 50
Quincy, ...	642	6	3	100 00	11,777 50
Randolph, ...	192	–	–	–	1,645 00
Raynham, ...	407	10	7	185 00	630 00
Reading, ...	409	4	1	35 00	2,450 00
Rehoboth, ...	1,269	25	12	327 50	525 00
Revere, ...	119	–	–	–	4,585 00

CITY OR TOWN.	Neat Cattle Assessed.	Number Tested.	Number Paid for.	Amount Paid.	State Tax.
Richmond,	448	-	-	-	$245 00
Rochester,	295	4	-	-	385 00
Rockland,	209	1	-	-	2,170 00
Rockport,	145	-	-	-	1,845 00
Rowe,	409	-	-	-	175 00
Rowley,	483	3	3	$90 00	490 00
Royalston,	619	39	24	732 00	437 50
Russell,	148	24	15	539 00	350 00
Rutland,	848	60	38	942 00	367 50
Salisbury,	421	23	5	145 00	465 00
Salem,	327	16	13	389 50	20,475 00
Sandisfield,	766	43	18	577 00	245 00
Sandwich,	214	11	3	80 00	682 50
Saugus,	656	-	-	-	2,065 00
Savoy,	592	19	2	41 00	122 50
Scituate,	345	1	-	-	1,435 00
Seekonk,	1,019	23	12	324 00	612 50
Sharon,	338	18	13	405 00	1,137 50
Sheffield,	592	8	2	61 00	630 00
Shelburne,	1,210	26	2	60 00	647 50
Shutesbury,	130	-	-	-	122 50
Sherborn,	742	16	15	449 50	577 50
Shirley,	409	13	6	119 00	525 00
Shrewsbury,	1,267	2	1	26 00	700 00
Somerset,	387	2	1	20 00	752 50
Somerville,	200	9	2	50 00	30,205 00
South Hadley,	1,070	20	3	80 00	1,645 00
Southampton,	1,027	10	9	260 00	350 00
Southborough,	1,085	33	24	686 00	1,137 50
Southbridge,	786	26	21	856 50	2,852 50
Southwick,	802	1	1	12 50	385 00
Spencer,	1,089	27	22	560 00	2,922 50
Springfield,	400	28	13	462 50	41,072 50
Sterling,	1,491	94	61	1,661 66	612 50
Stockbridge,	1,671	28	20	697 00	2,170 00
Stoneham,	233	8	8	308 00	2,835 00
Stoughton,	368	2	2	55 00	2,117 50
Stow,	857	107	86	2,858 00	455 00
Sturbridge,	770	14	4	92 00	682 50
Sudbury,	1,075	361	353	14,328 58	822 50
Sunderland,	775	60	17	558 00	297 50
Sutton,	962	75	45	1,418 50	945 00
Swampscott,	79	28	10	376 50	3,955 00
Swanzey,	926	1	-	-	612 50
Taunton,	762	8	-	-	13,965 00
Templeton,	506	52	14	469 50	980 00
Tewksbury,	531	87	17	615 00	1,050 00
Tisbury,	33	-	-	-	577 50
Tolland,	426	4	-	-	105 00
Topsfield,	684	17	13	515 00	612 50
Townsend,	418	27	13	384 50	840 00
Truro,	195	-	-	-	262 50
Tyngsborough,	415	28	20	701 00	280 00
Tyringham,	801	7	1	28 00	157 50
Upton,	548	4	3	87 00	735 00
Uxbridge,	712	19	6	180 00	1,592 50
Wakefield,	270	1	1	35 00	4,095 00
Wales,	250	2	-	-	210 00
Walpole,	523	12	9	317 50	1,452 50
Waltham,	770	77	70	2,614 50	13,055 00
Ware,	941	14	7	144 00	3,097 50
Wareham,	191	1	-	-	1,170 00
Warren,	1,422	19	7	167 50	1,960 00
Warwick,	275	5	1	14 00	227 50
Washington,	518	5	3	125 00	140 00
Watertown,	247	23	7	262 00	5,705 00
Wayland,	784	85	63	2,259 50	1,102 50

CITY OR TOWN.	Neat Cattle Assessed.	Number Tested.	Number Paid for.	Amount Paid.	State Tax.
Webster,	262	3	-	-	$2,695 00
Wellesley,	289	6	6	$209 50	4,655 00
Wellfleet,	98	-	-	-	542 50
Wendell,	188	-	-	-	175 00
Wenham,	398	1	-	-	472 50
West Boylston,	682	5	4	131 00	962 50
West Bridgewater,	759	47	21	917 50	700 00
West Brookfield,	1,025	41	28	718 50	595 00
West Newbury,	852	24	7	239 00	700 00
West Springfield,	695	27	12	392 50	2,887 50
West Stockbridge,	605	7	1	15 00	402 50
West Tisbury,	230	-	-	-	280 00
Westborough,	1,222	133	71	2,227 00	1,960 00
Westfield,	1,135	6	-	-	5,547 50
Westford,	809	44	39	1,209 30	962 50
Westhampton,	524	6	-	-	175 00
Westminster,	666	64	32	1,018 50	542 50
Weston,	914	102	95	3,243 50	2,502 50
Westport,	1,167	85	52	1,557 00	1,102 50
Westwood,	591	9	6	146 00	-
Weymouth,	529	2	-	-	4,777 50
Whately,	730	25	16	433 00	332 50
Whitman,	302	15	4	107 00	2,555 00
Wilbraham,	709	12	4	155 00	595 00
Williamsburg,	693	88	2	42 00	665 00
Williamstown,	1,380	-	-	-	1,767 50
Wilmington,	240	28	19	479 35	630 00
Winchendon,	476	10	5	121 00	1,645 00
Winchester,	176	-	-	-	4,532 50
Windsor,	752	14	2	57 00	140 00
Winthrop,	302	3	-	-	3,045 00
Woburn,	336	23	15	487 00	6,795 00
Worcester,	1,888	126	75	2,648 49	63,507 50
Worthington,	914	41	6	177 50	227 50
Wrentham,	483	24	18	654 50	1,067 50
Yarmouth,	140	-	-	-	1,470 00
Total,	210,801	9,991	5,435*	$185,448 56*	$1,750,000 00

The foregoing table does not include 254 animals which have been condemned, and warrants for which are now in the process of settlement. The estimated amount due for condemned cattle not paid for, and other outstanding bills, amount to $10,712.40.

The financial statement is as follows: —

Number cattle paid for as tuberculous, 5,275; amount paid,	$179,867 52
Number cattle paid for, no lesions found, 160; amount paid,	5,581 04
Quarantine expenses; amount paid,	2,928 11
Arbitration, amount paid,	27 75
Killing and burial expenses, amount paid,	125 93
Average per head for 5,435 cattle, $34.12; total amount paid,	$188,530 35
Amount carried forward,	$188,530 35

* These figures include 185 animals paid for in 1897 but quarantined and condemned in 1896.

Amount brought forward,		$188,530 35
Amount paid for commissioners' salaries,	$7,283 00	
Amount paid for agents' salaries,	13,561 54	
Amount paid for clerks' and stenographers' salaries,	5,201 04	
Expenses of commissioners,	3,781 80	
Expenses of agents,	11,869 28	
Expenses of office,	3,154 56	
Expenses of laboratory and experimental work,	1,515 17	
Expenses of implements,	1,883 75	
Expenses of quarantine stations,	3,870 35	
Expenses of glanders (killing and burial),	87 00	
		52,207 49
Total payments,		$240,737 84

During the year the average price per head has been	$34 12
For the first six months the average price per head has been	35 22
For the last six months the average price per head has been	30 45
For the last three months the average price per head has been	28 26
For the last one month the average price per head has been	29 69

The high average for the first six months and for the year is due in a great measure to the number of private tests that were made during the early months of the year.

Cash received during the year and turned over to the State Treasurer: —

For hides and carcasses,	$5,039 74
For sale of laboratory supplies,	76 09
For sale of pasture tags,	100 41
For use of telephone,	1 05
Total,	$5,217 29

In the work of inspecting the cattle in their respective towns the inspectors are supposed to make a physical examination of each animal on the premises. Any that they have reason to suspect as being diseased are placed in quarantine, to be examined later by the Cattle Commission, and either released or condemned, as may be decided. This work has gradually resulted in the advanced generalized cases of tuberculosis being picked out by the inspectors and destroyed,

until finally, as will be seen by an examination of the reports of the autopsies on the cattle killed, the cases of generalized or advanced cases of tuberculosis have become very scarce.

In the following tables the cases of advanced generalized tuberculosis among the cattle killed in 1897, excluding private test work, are compared with the reports for the years 1895 and 1896: —

Jan. 1 to Dec. 31, 1895.

Number of animals tested,	4,484.
Number of animals condemned and found diseased,	2,398, or 53.4 per cent.
General tuberculosis,	784, or 32.6 per cent.

Jan. 1 to Dec. 31, 1896.

Number of animals tested,	7,062.
Number of animals condemned and found diseased,	4,173, or 59.0 per cent.
General tuberculosis,	1,051, or 25.1 per cent.

Jan. 1 to Dec. 23, 1897.

Total number of animals tested to Dec. 23, 1897,	9,844.
Total number of animals condemned to Dec. 23, 1897,	5,062, or 51.43 per cent.
General tuberculosis to Dec. 23, 1897,	183, or 3.61 per cent.

It will be seen that these cases of advanced generalized tuberculosis have become very scarce, and these figures illustrate well the practical benefits resulting from this work.

In isolated cases or in out-of-the-way places the post-mortem examinations are often made by local inspectors. It is not unusual that they have had but little special training in this work, and their opinion as to whether the disease is generalized or not is not always reliable. As a check, therefore, on their averages, the following table was prepared from those cases where the autopsies were made at Brighton, or by reliable veterinarians; and it will be noticed that,

while the percentage is higher, yet it is close enough to confirm the averages for the year: —

Jan. 1 to Dec. 23, 1897.

Number of animals condemned and found diseased, the autopsies being made at Brighton or by reliable veterinarians, ...	3,590.
General tuberculosis,.	177, or 4.37 per cent.

The law further provides, in section 29, chapter 491 of the Acts of 1894, that "Every person, except the members of the Board of Cattle Commissioners, who has knowledge of, or has good reason to suspect the existence of, any contagious disease among any species of domestic animal within the limits of this Commonwealth, or that any domestic animal is affected with any such contagious disease, whether such knowledge is obtained by personal examination or otherwise, shall immediately give written notice thereof to the board of health of the city or town where such diseased animal or animals are kept."

During the early part of this year this section of the law had an important bearing on the work of the Board; for, immediately on the granting of the appropriation for the continuance of the work, the Board began to be deluged with quarantine papers and letters from veterinarians and others, reporting cattle that had reacted to the tuberculin test applied by veterinarians in private practice.

Under the law, the only thing to be done was either to accept the veterinarian's test or to retest the herd; this latter was often found to be unsatisfactory, because of the frequent failure of animals to react to a second test. The result was that to a large extent the control of the appropriation was taken out of the hands of the Board; the money could not be placed where, in the opinion of the Board, it would do the most good, and they further realized that they had no guarantee from the owners that an honest effort would be made by these owners to get rid of the disease.

In doing voluntary request work and in testing entire herds the Board had always insisted that the owner should

agree to observe the sanitary requirements prescribed by them, introduce none but tested animals into the herd without first having them tested with tuberculin, and thoroughly disinfect the premises. These precautions were considered necessary, because it was thought to be of little use to test an entire herd and kill those that reacted, in the expectation of freeing the herd of disease, if untested or diseased animals were to take the place of those condemned, or if tested animals were to be put into infected stalls or stalls that had not been properly disinfected. This matter had evidently not been thoroughly explained to many of the parties that had their herds tested by private veterinarians; and so, because of this, the following letter was sent to all whose herds had been tested in this manner: —

COMMONWEALTH OF MASSACHUSETTS.

BOARD OF CATTLE COMMISSIONERS,
COMMONWEALTH BUILDING, BOSTON, April, 1897.

DEAR SIR: — We desire to call the attention of owners of cattle, whose herds have been tested by private test, to section 45, chapter 491 of 1894, as amended by section 10, chapter 496 of 1895. This section provides for the killing of animals found to be affected with any contagious disease. It further provides that, "whenever any cattle condemned as afflicted with the disease of tuberculosis are killed under the provision of this section, the full value thereof at the time of condemnation, not exceeding the sum of sixty dollars for any one animal, shall be paid to the owner thereof out of the treasury of the Commonwealth, if such animal has been owned within the State six months continuously prior to its being killed; *provided*, such person shall not have, prior thereto, *in the judgment of the Cattle Commissioners, by wilful act or neglect, contributed to the spread of tuberculosis;* but such decision on the part of the commissioners shall not deprive the owner of the right to arbitrate, as hereinafter provided."

If an owner does not thoroughly cleanse and disinfect his barn, or if, after having had his herd tested and paid for by the State, he introduces untested animals into his herd, he has through his neglect contributed to the spread of tuberculosis in his herd, and, therefore, under this section forfeits his right to compensation for such tuberculous animals as may hereafter be found in his herd. The commissioners desire to call your attention to this matter, so that you may fully understand their position in regard to it.

You are hereby requested to notify the Board what steps you take toward disinfecting your barn, and the date that the work was completed. Please pay particular attention to this last request.

Yours truly,

AUSTIN PETERS, *Chairman.*
JOHN M. PARKER, *Secretary.*
LEANDER F. HERRICK.
MAURICE O'CONNELL.
C. A. DENNEN.

This was not thought to be sufficient, however, and on the 12th of April an agent was appointed to visit these owners and report on the condition of the barns. In the mean time, because of the amount of private testing that was being done, the Legislature took the matter up, and a committee was appointed to investigate the condition of the cows condemned in certain herds in the neighborhood of Dracut and Lowell. This committee made a special report to the Legislature on the matter; in their report the majority of the committee recommended that "all testing of cattle with tuberculin, when compensation is expected, be limited to the Cattle Commissioners or their authorized agents. The Board of Cattle Commissioners have already expended more than $160,000 of the total appropriation of $250,000 made earlier in the session. If they are compelled to kill all reacting animals and allow full compensation for the diseased cattle, the remainder of the appropriation will soon be exhausted. There will then be no money for the prosecution of the regular work of the commission, or the slaughter of those animals reported by the local inspectors as suspicious cases, and which are really the most dangerous animals to the health and comfort of the general public. The commissioners are not allowed to exceed their appropriation, hence all their work must stop when their money gives out."

As a result of this recommendation, the following law was passed and approved June 10, 1897: —

[CHAPTER 499 OF THE ACTS OF 1897.]

SECTION 1. No person having animals tested with tuberculin shall be entitled to compensation from the treasury of the Commonwealth for any animals that react to the tuberculin test, unless

such testing be done by the State Board of Cattle Commissioners, or their authorized agents acting as such at the time of the test, and such testing shall be subject to the supervision and control of the State Board of Cattle Commissioners.

SECT. 2. This act shall take effect upon its passage.

The names of the towns, the number of cattle in each herd and the value and numbers of those condemned previous to the passage of this act are as follows: —

Private Tests reported by Dr. W. E. Peterson.

OWNER.	Town.	Number Tested.	Number Condemned.	Amount.	Per Cent. of Disease.
C. Warren,	Waltham,	38	2	$65 00	5.26
P. Brodrick,	"	28	14	553 00	50.00
C. Viles,	"	37	34	1,298 00	81.89
School for Feeble-minded Children.	"	17	1	35 00	5.88
L. H. Bent,	Sudbury,	30	18	799 00	60.00
W. L. Stone & Son,	"	28	25	1,161 00	89.28
C. L. Noyes,	"	21	3	101 00	14.28
J. Quinn,	"	14	8	270 00	57.14
J. Rafuse,	"	18	14	547 00	77.77
G. A. Haynes,	"	56	13	574 00	23.21
F. Haynes,	"	17	5	197 00	29.41
H. M. Noyes,	"	19	16	637 00	84.21
F. W. Buttrick,	"	2	1	20 00	50.00
F. E. Bent,	"	6	3	123 68	50.00
G. Gilman,	"	5	2	92 00	40.00
F. Rouse,	"	13	6	218 00	46.15
G. Haynes,	"	11	4	104 00	36.36
J. Clark,	"	2	1	30 00	50.00
A. F. Hunt,	"	9	6	235 00	66.66
A. M. Thompson,	"	17	7	307 00	41.17
J. E. Bent,	"	16	12	565 00	75.00
Town Farm,	"	19	6	214 00	31.57
J. Austin,	"	17	12	513 00	70.58
F. P. Barton,	"	15	13	437 00	86.66
P. Maguire,	"	20	5	184 00	25.00
M. J. Haynes,	"	26	22	678 00	84.61
L. F. Flood,	"	18	12	566 00	66.66
J. Dwyer,	"	14	13	592 00	91.42
F. M. Bowker,	"	14	10	370 00	71.42
J. S. Rice,	"	11	7	305 50	63.63
A. Dakin,	"	10	-	-	-
R. W. Powers,	"	16	7	275 00	43.75
P. Pilkington,	"	14	9	331 00	64.28
C. E. Haynes,	"	14	4	149 00	28.57
L. P. Bent,	"	11	6	230 00	54.54
H. C. Bowers,	"	2	2	90 00	100.00
Goodnow Bros.,	"	11	7	252 00	63.63
E. McManus,	"	6	5	231 00	83.22
G. L. Goodnow,	"	6	-	-	-
E. Goodnow,	"	13	7	373 00	53.84
S. D. Perry,	"	23	22	1,039 00	95.65
T. F. O'Neil,	"	14	4	191 00	28.57
E. Senett,	"	4	1	35 00	25.00
C. W. Rice,	"	28	12	457 00	42.85
J. E. Bent,	Maynard,	9	1	40 00	11.11
S. G. Brown,	"	8	7	289 00	87.05
D. Mynahan,	"	15	2	92 50	13.33

OWNER.	Town.	Number Tested.	Number Condemned.	Amount.	Per Cent of Disease.
J. H. Sullivan,	Maynard,	23	14	$595 00	60.86
H. B. Fowler,	"	20	9	367 00	45.00
G. F. Brown,	"	1	1	32 00	100.00
J. F. Parmenter,	"	23	19	784 00	82.06
W. F. Litchfield,	"	3	1	38 00	33.33
C. Brooks,	"	5	5	220 00	100.00
J. A. Johnson,	"	6	6	225 00	100.00
J. H. Vose,	"	12	6	218 00	50.00
E. B. Wilcomb,	"	11	7	218 00	33.33
C. A. Whitney,	"	15	7	248 00	46.66
G. E. Whitney,	"	14	6	220 00	42.84
G. A. Whitney,	"	1	1	32 00	100.00
L. C. Colbert,	"	6	2	75 00	33.33
C. Randall,	"	5	4	170 00	80.00
W. Parmenter,	"	10	1	40 00	10.00
M. W. Hynes,	Wayland,	10	3	140 00	30.00
T. L. Hynes,	"	4	2	85 00	50.00
H. Walker,	"	14	1	40 00	7.14
G. Patterson,	Stow,	16	5	178 00	31.25
H. S. Hapgood,	"	20	14	429 00	70.00
W. H. Lord,	"	12	10	360 00	83.33
B. C. Brown,	"	3	–	–	–
G. W. Bradley,	"	4	3	102 00	75.00
Benj. Clark,	"	8	6	238 00	75.00
A. W. Puffer,	"	4	4	172 00	100.00
A. Tuttle,	"	8	8	263 50	100.00
F. W. Hapgood,	"	2	1	52 00	40.00
W. Toohey,	"	5	2	65 00	–
P. A. Gately,	"	5	–	–	–
J. J. Gately,	"	13	3	108 00	23.07
J. Lund,	"	1	–	–	–
F. Bond,	"	6	–	–	–
J. Johnson,	"	6	2	77 00	33.33
W. C. Robbins,	Acton,	50	33	1,375 00	66.00
C. B. Robbins,	"	24	21	721 00	87.05
A. Cole,	"	18	11	491 00	61.11
J. K. W. Wetherbee,	"	10	8	306 00	80.00
H. D. Clark,	Weston,	13	11	499 00	84.61
F. B. Ripley,	"	10	8	324 00	80.00
L. E. Roberts,	"	18	14	444 00	77.77
G. B. Milton,	"	7	2	63 00	28.56
C. H. Bryden,	"	18	17	620 00	94.44
H. Zoller,	"	42	23	670 00	54.76
A. G. Loker,	"	18	11	354 00	61.11
M. L. Currant,	Lexington,	29	17	746 00	58.60
S. M. Lawrence,	"	35	31	1,249 00	88.57
E. T. Payson,	"	2	2	70 00	100.00
H. E. Barnes,	Lincoln,	15	8	390 00	53.33
R. Sherman,	"	12	1	32 50	8.33
L. Mayer,	"	18	18	831 00	100.00
D. H. Sherman,	"	32	8	347 00	25.00
H. J. Harrington,	"	11	4	157 00	36.36
J. Thompson,	"	8	8	268 00	100.00
G. Miles,	Concord,	23	23	787 00	100.00
C. H. Bryan,	"	7	6	243 00	85.71
J. A. Hager,	Marlborough,	24	12	557 00	50.00

Private Tests reported by Dr. A. J. Sheldon.

R. Fox,	Dracut,	41	30	$1,245 00	73.17
D. S. Fox,	"	10	8	300 00	80.00
C. E. Jones,	"	15	10	372 00	66.66
F. A. Fox,	"	51	48	1,567 68	94.11
E. T. Fox,	"	17	8	384 80	47.05

OWNER.	Town.	Number Tested.	Number Condemned.	Amount.	Per Cent. of Disease.
A. J. Thissell,	Dracut,	10	7	$296 52	70.00
O. Merrill,	"	14	2	75 00	14.28
Thompson Island Farm School.	Boston,	{ 33	28	1,280 00	84.84
		26	15	685 00	57.69
D. M. Davis,	Newburyport,	9	2	55 00	22.22
G. A. Minot,	"	2	2	62 00	100.00
G. Dokum,	"	10	1	38 00	10.00
J. M. Chase,	"	11	3	95 00	27.27
W. H. Safford,	"	5	2	90 50	40.00
A. T. Newhall,	"	21	10	298 50	47.61
F. D. Moseley,	"	32	7	181 00	21.87
C. P. Bartlett,	"	20	14	529 50	70.00
J. Mahoney,	"	5	1	45 00	20.00
E. G. Moseley,	"	2	1	30 00	50.00
G. F. Penniman,	Chelmsford,	20	13	627 00	65.00
J. Plummer,	"	22	7	269 00	31.81
H. D. Pierce's estate,	Canton,	57	3	135 00	5.43
Town Farm,	Billerica,	18	13	558 00	66.66
J. N. Pardee,	"	5	2	70 00	40.00
W. Holden,	"	23	4	203 00	17.39
N. R. Jones,	"	23	15	667 00	65.22
A. Woodward,	"	3	3	165 00	100.00
G. E. Simons,	"	5	5	270 00	100.00
J. Sullivan,	"	6	6	191 88	100.00
B. Kerney,	"	5	4	215 00	80.00
D. Lane,	"	12	11	504 67	91.66
J. E. Rowell,	"	18	11	559 50	61.11
H. Dutton,	"	1	1	45 00	100.00
F. A. Patch,	Boxborough,	36	9	332 00	25.00
Geo. Mixter,	Hardwick,	68	1	15 00	1.48

Private Test reported by Dr. J. F. Winchester.

J. Plummer,	Chelmsford,	11	9	$408 00	81.81

Private Tests reported by Dr. M. Bunker.

T. L. Lane,	Wayland,	25	17	$577 50	68.00
J. T. Cowen,	"	10	7	222 50	70.00
F. S. Kimball,	Brighton,	-	-	-	-

Private Test reported by Dr. G. N. Kinnell.

Baker Bros.,	Lanesborough,	42	37	$1,217 00	88.08

Private Tests reported by Dr. C. S. Moore.

F. Kimball,	Danvers,	17	4	$170 00	23.53
B. W. Perry,	"	-	1	-	-
J. E. Porter,	"	8	7	262 00	87.49
J. B. McCarthy,	"	12	5	265 00	41.66
O. F. Putnam,	"	-	1	35 00	-
J. M. Putnam,	"	8	3	70 00	27.49
J. Swinerton,	"	2	1	20 00	50.00

Private Test reported by Dr. J. H. Seale.

OWNER.	Town.	Number Tested.	Number Condemned.	Amount.	Per Cent. of Disease.
M. Thurlow, . . .	Amesbury, .	8	8	$262 00	100.00

Private Test reported by Dr. A. H. Streeter.

W. A. Harlow, . .	Cummington, .	18	9	$340 00	50.00

Private Test reported by Dr. A. L. Cundall.

J. D. Tyler, . . .	Berlin, . .	14	2	$52 50	14.28

Private Test reported by Dr. A. S. Cleaves.

E. W. Goddard, . .	Barre, . .	3	1	$30 00	33.33

Private Tests reported by Dr. C. A. Hamblet.

R. D. Coburn, . . .	Dracut, . .	-	1	$50 00	-
E. T. Fox, . . .	" . .	-	10	511 00	-
N. D. Peavey, . . .	" . .	4	3	125 00	75.00
F. R. Hill, . . .	" . .	-	2	87 50	-
G. Brown, . . .	" . .	-	1	47 50	-

Private Test reported by Dr. W. S. Eaton.

E. Mills, ...	Dracut, . .	5	4	$150 00	80.00

Private Tests reported by Dr. E. Knobel.

G. W. Wetherbee, . .	Dedham, .	2	2	$55 00	100.00
G. Reed, ...	" .	2	2	50 00	100.00

Private Test reported by Dr. J. H. Dutton.

J. P. Emerson, . .	Chelmsford, .	40	11	$405 00	27.05

Private Test reported by J. W. Robinson.

C. Whitemore, . . .	Natick, . .	28	18	$766 00	64.28

Private Test reported by Dr. S. O. Fowle.

OWNER.	Town.	Number Tested.	Number Condemned.	Amount.	Per Cent. of Disease.
A. R. Jones, . . .	Wellesley, .	-	1	$35 00	-

Private Tests reported by Dr. G. N. Kinnell (2d test).

J. Kirfhner, . . .	Dalton, . .	16	-	-	-
J. A. Bourgner, . .	" . .	18	-	-	-
G. Loehr, . . .	" . .	13	-	-	-
W. Kirihner, . . .	" . .	15	-	-	-
H. Finger, . . .	Lanesborough,	14	-	-	-
Thomas Brennan, . .	"	19	-	-	-
J. E. Lamb, . . .	"	8	-	-	-
Dow Bros., . . .	"	8	-	-	-
E. A. Wood, . . .	"	24	-	-	-
D. B. Dewy, . . .	Lenox, . .	25	-	-	-
F. E. Curtis, . . .	" . .	23	-	-	-
F. S. Clark, . . .	Richmond, .	18	-	-	-
F. Loehr, . . .	Washington, .	23	3	$125 00	13.04
J. Newbury, Jr., . .	" .	30	-	-	-
J. Eichelser, . . .	" .	22	-	-	-
P. Eichelser, . . .	" .	21	-	-	-

These figures are interesting, because they show relatively the amount of disease in a large number of herds. It will be noticed that the herds in the western part of the State show only a very small proportion of disease. These herds had previously been tested and cleaned up, this being the second test.

It would appear also that there are fewer cows in the western part of the State that react, and consequently the barns there are not so saturated with infectious material. These tests, however, have their value as tending to show on a large scale what proportion of the cattle in the State would react to the test. The proportional number of reacting animals would appear to be exaggerated, were it not for the fact that these figures are corroborated by other herds tested at various intervals by different parties, where the per cent. of disease appears to be about the same. The only conclusion that we can arrive at, then, is that the number of animals that react to the test is extremely large. Fortunately, by far the larger proportion of these cases have only slight localized tuberculosis, the majority of which might never develop.

While this testing was going on, and previous to the passage of the law relating to private testing of herds, the Board began to realize the necessity for the passage of some such law. It was evident that many of these owners had not realized what they were undertaking; it was evident that others had no intention of co-operating with the State in endeavoring to get rid of the disease, and certainly there was little use in attempting to help those who would not try to help themselves. Being written to and talked to seemed to have little effect; it was only when told that they were laying themselves liable to forfeit their right to compensation in the future that there was any perceptible improvement. (See letter to owners of herds tested by private test, page 465.)

In this connection, the report on the amount of cleansing and disinfection that has been done by these owners is instructive: —

	Filthy Stables.	Unclean Stables.	Clean but not Disinfected.	Satisfactory Stables.
First visit, . .	11	42	35	52
Second visit, . .	4	7	32	33
Third visit, . .	2	4	4	3

It will be noticed that, after being written to, in only 52 out of 140 barns first visited had the owners cleansed or disinfected their premises after the removal of diseased animals. On the second visit the showing was a little better, — 85 out of the 140 visited had been cleaned and were in a satisfactory condition; but it was not only in the case of those having had their herds tested by private test that disinfection was ordered. All barns from which cattle were taken, as tuberculous, were ordered disinfected, and inspectors were instructed to call the attention of owners to section 45, chapter 491, etc.: —

Inspectors will please call the attention of owners to section 45, chapter 491 of the Acts of 1894, as amended by section 10, chapter 496 of the Acts of 1895. This section makes provision for the

compensation of owners, provided "such person shall not have, prior thereto, in the judgment of the Cattle Commissioners, by wilful act or neglect contributed to the spread of tuberculosis." If after suitable notice an owner introduces diseased animals into his herd, or fails to thoroughly disinfect his premises, he contributes to the spread of tuberculosis by neglecting to take reasonable precaution against the spread of the disease, and lays himself liable to forfeit his right to compensation.

The regulations issued by the Board bearing on this subject are as follows: —

Regulations of Massachusetts Board of Cattle Commissioners for cleansing and disinfecting Barns.

[These must be complied with by owners of cattle which the State pays for.]

In attempting to get rid of tuberculosis in a herd of cattle, it should be remembered that not only is it necessary that all the diseased animals be picked out and either isolated or destroyed, but that no new animals should be introduced unless they have been tested and are known to be free from disease.

The barns should also undergo a thorough renovation, and be properly cleansed and disinfected before they are again occupied.

In renovating or remodelling barns, the great importance of sunlight, thorough ventilation and good drainage should always be borne in mind.

Disinfection of the barns is always necessary to destroy any infectious material that may have been left after the removal of diseased cattle. The best disinfectant we know is sunlight. Germs of disease will live but a short time when exposed to the direct rays of the sun; and for this reason, if for no other, a southerly exposure and plenty of windows in the barn are to be desired.

In proceeding to disinfect a barn, the first and perhaps the most important step to be taken is to collect all rubbish, have the walls, ceilings and floors thoroughly swept and cleansed of all litter, dust, cobwebs and the like. The floors, mangers, feeding troughs and stanchions should be carefully scraped and cleaned, special care being taken with the corners, and all of the rubbish collected and burned.

All odds and ends of boards and old broken mangers and partitions should also be removed and burned, and, when occasion requires it, new plank floors should be laid in place of old ones.

After cleansing thoroughly with hoe and broom, and hose if running water is convenient, and, if the barn contains a boiler, with scalding water or live steam, applied with a hose, or, failing

that, with boiling water and soft soap or washing soda, a solution of bichloride of mercury (corrosive sublimate), 1 to 1,000 parts of water, should be applied with a whitewash brush and poured over the floors (corrosive sublimate should be used in wooden vessels, as it corrodes metal ones).

After applying the corrosive sublimate, the ceilings, walls, partitions, mangers, etc., should again be washed and gone over with warm, freshly made whitewash; a half pound of chloride of lime to the gallon of whitewash is an addition that may make it more effective. Fumigating with sulphur or chloride gas is not of any great value in ordinary stables.

In using corrosive sublimate, it must be borne in mind that it is a dangerous poison, and mangers and partitions should be carefully washed after applying this mixture, and then again scalded or whitewashed.

If at a season of the year when the animals can be turned out, the stables should be left vacant for some time, with doors and windows open.

Six months after the first test the herd should again be tested and undergo a careful physical examination, so as to be certain that no diseased animals have been overlooked, and the barns should again be thoroughly disinfected.

Great care should also be taken that all animals have been tested before their introduction to the herd.

It would appear, from the report of the inspector, that this work needed to be looked after. It will be noticed that, out of over 700 barns visited, only 59 had been cleansed and disinfected satisfactorily at the first visit; on the second visit the figures were reversed, and instead of 397 filthy barns there were only 43. The work is summed up as follows: —

	Filthy Stables.	Unclean Stables.	Clean but not Disinfected.	Satisfactory Stables.
First visit, . .	397	141	120	59
Second visit, . .	43	37	211	234
Third visit, . .	3	11	106	26

The general law under which the inspectors are appointed further provides, under section 20, chapter 491 of the Acts of 1894, as amended by section 6 of chapter 496 of the Acts of 1895, that "inspectors must be present at all

licensed slaughter houses or establishments upon the day or days designated for slaughter, and there carefully examine at the time of slaughter the carcasses of any and all neat cattle, sheep and swine slaughtered thereat. And it shall be the duty of such inspectors also to examine at the time of slaughter any and all neat cattle, sheep and swine when owned by any person not engaged in such business, and when the same are slaughtered upon his own premises other than a slaughter house, etc., unless the said animal is less than six months old, or has been inspected within six months prior to such slaughter, and a certificate of health has been delivered to the owner or person in charge."

Under section 5, chapter 491 of the Acts of 1894, every inspector shall keep a record of all inspections and his doings thereon, and shall make regular returns of all such inspections to the Board of Cattle Commissioners. Under this provision the inspectors have reported the following work: —

Number of cattle inspected at time of slaughter, under section 21,	975
Number of sheep inspected at time of slaughter, under section 21,	157
Number of swine inspected at time of slaughter, under section 21,	3,345
Number of cattle inspected at licensed slaughter houses at time of slaughter,	187,416
Number of sheep inspected at licensed slaughter houses at time of slaughter,	405,201
Number of swine inspected at licensed slaughter houses at time of slaughter,	1,468,334
Total number of animals inspected at time of slaughter, including those inspected at licensed slaughter houses, and also under section 21,	2,065,428

Cattle destroyed as tuberculous,	302
Sheep destroyed as tuberculous,	*2
Swine destroyed as tuberculous,	105
Percentage of cattle found infected,	.16
Percentage of sheep found infected,	–
Percentage of swine found infected,	.0071
Number of towns with licensed slaughter houses,	102
Number of licensed slaughter houses,	228

* These were probably not tuberculous, but were cases of Œsophagostoma Columbianum, wnich was very likely mistaken for tuberculosis by the local inspector.

The second division of the work — the examination of all cattle coming into the markets at Brighton, Watertown and Somerville from without the State for sale, — is an exceedingly important one. Its object of course is to provide a market where those desiring to secure tested cows can do so. This is important, and would be valuable if it were possible to rely on these tests as correct; unfortunately, there is frequently good reason for doubting the reliability of many of them.

During the year from Dec. 15, 1896, to Dec. 15, 1897, the number of cattle received at Brighton has been as follows: —

Maine cattle,	12,040
New Hampshire cattle,	1,890
New York cattle,	689
Massachusetts cattle,	9,964
Western cattle,	14,719
Sheep,	55,260
Swine,	639,374
Veals,	28,878
Horses,	4,060
Cattle released by certificate,	10,540
Cattle tested,	171
Cattle released after test,	141
Cattle released for slaughter,	9
Cattle condemned,	21

Watertown, Dec. 15, 1896, to Dec. 15, 1897.

Vermont cattle,	6,609
New Hampshire cattle,	8,144
New York cattle,	274
Massachusetts cattle,	933
Western cattle,	171,562
Sheep,	514,608
Swine,	766,920
Veals,	63,927
Horses,	24,762
Cattle released by certificate,	8,240
Cattle released by pasture tags,	99
Cattle tested,	42
Cattle released after test,	34
Cattle released for slaughter,	1
Cattle condemned,	7

Somerville, Dec. 15, 1896, to Dec. 15, 1897.

Western cattle,	114,562
New England cattle (Vermont and New Hampshire),	4,421
Massachusetts cattle,	1,082
Sheep,	367,202
Calves,	46,262
Hogs,	13,172
Cattle released on certificates,	688
Cattle tested and released,	14
Cattle condemned, actinomycosis,	2

Recapitulation.

Total number cattle for beef,	346,889
Total number sheep,	937,070
Total number hogs,	1,419,466
Total number calves,	139,067
Total number horses,	28,822
Total number released on certificates,	19,468
Total number tested at stations,	227
Total number released at stations,	199
Total number condemned at stations,	28
Total number condemned for actinomycosis,	2

In all from Dec. 15, 1896, to Dec. 15, 1897, 346,889 cattle have passed through Brighton, Watertown and Somerville from outside the State. During the same period of time, from Dec. 15, 1896, to Dec. 15, 1897, 7,068 cattle have been admitted to the State on special permit.

This division of the work, the examination and identification of cattle coming in from without the State upon special permit, also deals with the admission of out-of-State cattle; and it has been found that the difficulties and disadvantages to be met with at the Brighton, Watertown and Somerville markets are to be met with in this department of the work as well. It is expected, of course, that these cattle are tested either before or after arrival.

The table following shows the number of cattle brought in month by month on special permit, making in all 7,068 cattle brought in on 492 permits: —

From Dec. 15, 1895, to Dec. 31, 1896,	421
January, 1897,	333
February, 1897,	261
March, 1897,	462
April, 1897,	289
May, 1897,	198
June, 1897,	315
July, 1897,	325
August, 1897,	703
September, 1897,	857
October, 1897,	1,374
November, 1897,	1,187
December, 1897,	343
Total,	7,068

The question of the advisability of placing quarantine restrictions on cattle coming into a country or State is one that is thoroughly well established. In Europe quarantine regulations and the requirement of the tuberculin test is very general. On this continent both the United States and Canadian governments require it, and it is also required by several of the different States before cattle are permitted to pass their borders. Unfortunately, the difficulties in its enforcement are great. The alternative consists in the Board appointing their own agents to do the testing in the various States from which the cattle are generally shipped. Consequently, at a meeting of the Board, held October 2, it was decided that the Board should appoint their own agents to do the testing on cattle coming in from without the State; and in pursuance with this decision the following letters were prepared, and will be issued as soon as the list of out-of-State agents is completed: —

Letter to Agents.

BOSTON, Jan. 1, 1898.

DEAR SIR: — The Massachusetts Board of Cattle Commissioners is of the opinion that, in order to protect the cattle owners of Massachusetts from bovine tuberculosis to the greatest practicable extent, the work of testing cattle outside the State, to be brought into Massachusetts, should be done in the most careful and efficient manner possible.

In order to perfect this branch of our work as far as we are able, it has been decided to consider those testing cattle with tuberculin, for farmers and dealers, to be brought into this State,

as our agents outside of this Commonwealth, and this Board will only accept the tests of such men as we approve of.

All tests are to be made at the expense of the owners or buyers, and not at that of the Massachusetts Cattle Commission.

Each tested animal must have an ear-tag, furnished by this Board at cost; the number on the ear-tag must correspond with the number on the certificate; and the appearance of the animal must also agree with the description of the certificate, otherwise the certificate will be considered valueless.

You have been approved of by the Massachusetts Board of Cattle Commissioners to test neat cattle to be shipped to Massachusetts, and we will continue to accept your tests as long as we are of the opinion that they are being made in a careful and conscientious manner; if at any time, however, we have reason to be dissatisfied with your work, we retain the privilege of summarily dropping your name from our list.

We also request you to keep us informed as to the source of the tuberculin you use, the strength of the solution and size of dose, all of which must meet with our approval.

Per order,

MASSACHUSETTS BOARD CATTLE COMMISSIONERS.

Letter to Dealers.

BOSTON, Jan. 1, 1898.

DEAR SIR: — The Massachusetts Board of Cattle Commissioners is of the opinion that, in order to protect the cattle owners of Massachusetts from bovine tuberculosis to the greatest practicable extent, the work of testing cattle outside of this State, to be brought in here, should be done in the most careful and efficient manner possible.

In order to perfect this branch of our work as far as we are able, it has been decided to consider those testing cattle with tuberculin, for dealers and farmers, to be brought into Massachusetts, as our agents outside of this Commonwealth, and this Board will only accept the tests of such men as we approve of.

A printed list of the men we consider reliable will be furnished on application. This list may be revised from time to time, as new applicants may be added or men who prove either dishonest or incompetent are dropped from it.

All tests are to be made at the expense of the owners or buyers of the animals, and not at that of the Massachusetts Cattle Commission.

All neat cattle over six months old brought into the State purporting to have been tested will be quarantined and tested, unless

such test has been made by an authorized out-of-the-State agent of the Massachusetts Board of Cattle Commissioners.

Each tested animal must have an ear-tag, furnished by this Board at cost; the number of the ear-tag must correspond with the number on the certificate; and the description on the certificate must also agree with the appearance of the animal, otherwise the certificate will be considered valueless.

Per order,

MASSACHUSETTS BOARD CATTLE COMMISSIONERS.

The fourth division of the work, the conduct of laboratory and stable experiments to determine problems connected with the work of the Board, has been fruitful of results. Under this head may be classed the retesting of certain herds that had previously been tested by the Board. This work illustrates well the difficulty that sometimes exists in freeing a herd from tuberculosis. The work has been tabulated, and shows that in some cases the herds have been tested several times, yet, although possibly to a less extent, the disease still exists in many of these herds.

	1894.			1895.			1896.			1897.		
	Number Tested.	Number Condemned.	Per Cent.	Number Tested.	Number Condemned.	Per Cent.	Number Tested.	Number Condemned.	Per Cent.	Number Tested.	Number Condemned.	Per Cent.
Henry Heywood, Gardner,	-	-	-	81	30	37.03	50	27	54.00	100	31	31.00
	-	-	-	-	-	-	-	-	-	106	12	11.32
P. M. Harwood, Barre, .	-	-	-	27	20	74.07	9	1	11.11	-	-	-
T. P. and C. S. Root, Barre,	-	-	-	36	3	8.33	29	5	17.24	-	-	-
G. L. Clemence, Southbridge.	-	-	-	26	5	19.23	34	5	14.70	-	-	-
F. B. Bridgeman, Westhampton.	-	-	-	11	5	45.45	22	5	17.85	-	-	-
Baker Brothers, Lanesborough.	-	-	-	-	-	-	42	37	88.09	21	-	-
Geo. H. Ellis, West Newton.	69	29	42.02	-	-	-	79	13	16.04	134	23	17.16
	-	-	-	-	-	-	68	2	2.09	148	6	4.05
Geo. H. Ellis, Concord, .	-	-	-	-	-	-	64	6	9.37	38	1	2.63
	-	-	-	-	-	-	-	-	-	62	4	6.45
Geo. H. Ellis, Kendal Green.	-	-	-	-	-	-	74	20	27.02	49	5	10.20
	-	-	-	-	-	-	-	-	-	50	-	-
F. B. Page, Gardner, . .	-	-	-	28	3	10.70	-	-	-	30	3	10.00
J. Eichelser, Washington, .	-	-	-	18	2	11.11	-	-	-	22	-	-
Farm School, Thompson Island.	-	-	-	28	3	10.71	-	-	-	26	15	57.69
	-	-	-	-	-	-	-	-	-	30	-	-

NOTE. — The difference in these figures between the number of animals tested on the first and later tests is accounted for by the purchase of new animals that *had been tested* or by the natural increase in the herd.

In the case of Mr. Ellis's herd an endeavor was made to locate the source of reinfection, and the diseased portions of six of the last cows were submitted to Prof. Theobold Smith, to get an opinion as to the age of the lesions. His opinion on this point was a singularly strong confirmation of the opinion that the cattle contracted the disease after their introduction to the barn. These cows were tested and appeared all right before being bought. They reacted after three months had elapsed; on autopsy the lesions were found to be slight, and on examination by Professor Smith he stated that in his opinion they were only from two to three months old. This would seem to indicate that the disease was probably contracted in the barn, and corroborates the opinion held by the Board of the danger to cattle recently introduced into infected barns. This danger exists to a greater or less extent in all barns that have been inhabited by diseased cattle.

Another idea that naturally suggests itself is that it might be well to advise every farmer or owner in the State to cleanse and whitewash his barn say twice a year, whether any cattle have been taken out or not; in this way, if any infectious material existed in the barn it would at least be reduced in quantity, the danger would be lessened, and of course if this disinfection was kept up it would materially lessen the amount of infectious material, and therefore lessen the danger to the other cattle in the barn. On the other hand, if neither diseased cattle nor infectious material had been in the barn, it would at least do no harm to wash and whitewash, and it would tend to inculcate ideas of cleanliness where perhaps they had been wanting.

During the year, on the request of several owners, and on their promising to observe certain conditions, a number of animals that had reacted to the test were kept in quarantine in separate buildings for observation and experimental purposes.

In the month of December, 1894, a bull belonging to G. H. Ellis of Newton was tested, with the following reaction: —

Dec. 28, 1894 — 7.30 A.M., 101; 5 A.M., 99.4; 7 A.M., 101.1; 9 A.M., 101; 12 M, 101.1; 3 P.M., 103.1; 5 P.M., 102.3.

It has since been tested six times, showing the following reactions: —

March 18, 1896 — 8 P.M., 101; 6 A.M., 101, 101.2, 103.4, 104.4, 104.3, 104.2, 104.3, 104.2, 103.
June 13, 1896 — 9.30 P.M., 101.1; 7.30 A.M., 102.3, 103.1, 103.1, 103, 103, 103, 101.3.
June 20, 1896 — 9.30 P.M., 101; 6.30 A.M., 101.2, 101.3, 101.2, 101.2, 101.3.
Aug. 18, 1896 — 7 P.M., 101.2; 5 A.M., 101.1, 101, 102.2, 103.4, 104, 103.4, 103.4.
Aug. 18, 1897 — 8 P.M., 101, 101.1; 7 A.M., 101.2, 103.1, 104.3, 105.
December, 1897 — 6 P.M., 101; 4 A.M., 100.3, 100.3, 100.2; 100.1, 100.

It will be noticed that the bull was tested June 13, and again on June 20. At the second test there was no reaction; this is a characteristic of tuberculin, as frequently there is no reaction at a second test until a considerable time has elapsed.

On the last test, in December, 1897, there was again no reaction; but whether this was due to an insusceptibility to the test or to the cure of the disease, it is impossible to say at the present time.

In the month of February, 1897, the Board received notice from Dr. Kinnell of Pittsfield that he had tested a herd of Siementhal cattle, consisting of four cows and a bull, two of which had reacted to the test. These tests were accompanied by a letter from Dr. Kinnell, which is as follows: —

WILLIAM DOUGLAS SLOANE, Esq., *Lenox.*

Four Cows and a Bull tested Feb. 11 and 12, 1897. — Breed, "Siementhal" Cattle.

Numbers on Horns.	10 P.M.	8 A.M.	10 A.M.	12 M.	2 P.M.	REMARKS.
635	101	101.2	100.2	100.6	101.4	- -
414	100.8	103	105	108	107	- -
76	101	102.6	102.2	101.4	101.4	Heavy in calf.
71	101	102.4	102.8	102.4	102	Aborted four weeks ago.
Bull.	101.6	106	107	106.6	105.4	- -

No. 414 had a chill, commencing twelve hours after injection and continuing four hours. She was noticed to cough during the chill. Bull had a chill, commencing at eighth hour after injection and lasting six hours.

Dr. Parker, *Secretary Massachusetts Cattle Commission.*

Dear Sir: — These animals were imported from Belgium about six months ago. They were kept in quarantine for three months, Garfield, N. J., and brought here on a permit from your office last September (1896). They were at once put in quarantine by Inspector Flint of Lenox, and have been so kept ever since.

In regard to Nos. 635, 76 and 71, I would say that I consider them free from tuberculosis. Nos. 76 and 71 gave slight reactions, but, from the fact that they showed no constitutional symptoms, and from the fact that No. 414 and the bull gave such decided reactions, I should think that the slight reaction was due to the peculiar conditions under which they have been kept, and perhaps also due to their breeding. In addition to these, one of them aborted comparatively recently, and the other is heavy in calf.

The owner of these animals purchased and brought them to this country at very great expense, and, apart from that, is most anxious to establish a herd of this breed. Consequently, I am commissioned to write to you and try if we cannot arrange to deal with them somewhat differently than with ordinary cases. Knowing that with proper care it is quite possible to breed sound stock by this bull and from the diseased cow, we would like it if you would allow this cow and bull to remain permanently in quarantine or until further orders, and not to slaughter them. Mr. Sloane is willing to give every assurance and guarantee that they will not be sold, or moved from the farm, or killed for beef, or brought into contact with other animals, except of course in the case of the bull being allowed to copulate with the cows.

I would say that Mr. Sloane fully appreciates the dangers of tuberculosis, and is fully in sympathy with all that is being done to eradicate it. Two years ago he cleaned up his herd of blooded Jerseys at great pecuniary loss, and would not now do anything that would in the least endanger the health of his herd; and any special features of quarantine which you might suggest or wish in regard to these animals would be rigidly carried out. But, if this is more than you as a State official can grant, would not the fact that they have been brought such a long journey and have been kept under such varied and trying conditions justify you in keeping them indefinitely in quarantine for retest?

Hoping that this may meet with the favorable consideration of your Board, I remain,

Truly yours, Geo. N. Kinnell.

P.S. Of course Mr. Sloane would agree to waive all claims for quarantine expenses, and would sterilize or destroy the products from the diseased cow, as you might direct. G. N. K.

On receipt of this letter from Dr. Kinnell, the owner was communicated with and the following answer received: —

642 FIFTH AVENUE, N. Y., Feb. 18, 1897.

JOHN M. PARKER, Esq., *Secretary*.

DEAR SIR: — Your favor of the 16th has been forwarded to me from Lenox.

The few "Siementhal" cattle I possess form part of a herd imported last August, and were at the United States government quarantine station until end of November. The large portion of the herd are now in New York, and were inspected by the State veterinarian and given a clean bill. I cannot but think that in my case the reaction from test shown in two of my herd must be due to some climatic conditions, for tuberculosis is not known in the locality from which these cattle come. My main object in importing them was to cross them with my Jerseys. As latter breed seemed sensitive to the disease, I shall be glad to have Dr. Kinnell confer with my manager again; latter will carry out whatever instructions he may receive. Yours truly, WM. D. SLOANE.

After a meeting of the Board, the owner and Dr. Kinnell were both communicated with. The letter to the owner was as follows: —

COMMONWEALTH OF MASSACHUSETTS.

BOARD OF CATTLE COMMISSIONERS, BOSTON, March 1, 1897.

Mr. W. D. SLOANE, *642 Fifth Avenue, New York*.

DEAR SIR: — As I promised you, I brought the matter referred to in my last letter to you before the meeting of the Board, held on February 22, and I am instructed to write you that the Board is willing that you should be allowed to keep the cattle and breed from them, providing that we have your guaranty that they will be kept separate from the rest of the herd, that the State will not be called upon to pay for quarantine expense, that no milk will be sold from the cow, and that the Board are kept informed of the results of any further tests.

Of course you can easily see why we ask this of you, because, if this cow is allowed to mix with the rest of the herd, it would not be fair for the State to pay for any animals that might contract the disease from her; at the same time, we do not wish to put any person to the expense of bringing valuable cattle into the State and stop his breeding from them, if he so desires; in fact, we will be willing to do everything in our power to further the breeding and improvement of cattle in this direction.

Yours truly, JOHN M. PARKER, *Secretary*.

The two reacting animals were kept entirely separate from the herd, and had separate yards to run in. On this matter Dr. Kinnell writes as follows: —

PITTSFIELD, MASS., Feb. 19, 1897.

DEAR DR. PARKER: — We were very glad to have your notice of a provisional permission to retain the bull and cow at Mr. Sloane's in quarantine. The bull is kept in a box stall apart from the other houses, a stall specially built for him; the cow will be kept in another stall being constructed for her, and each will have yards to themselves apart from all the other stock. In a few days I will be down there again to see arrangements completed.

On January 2 and 3, 1898, the bull was again tested, with the following result: —

10 P.M., 102.1; 8 A.M., 106; 10 A.M., 106.1; 11.30 A.M., 106.2; 1 P.M., 106.

Dr. Kinnell notes that: —

This bull has been going back for the last four months; does not keep up in condition, and coughs a great deal. I could not by auscultation detect anything but violent percussion made him cough. He has been used on the cows until within a few weeks, and has proved satisfactory in getting the cows with calf. From eight o'clock until eleven this morning he was suffering from a chill, trembling, eyes running and his cough aggravated.

G. N. K.

The test on the cow was as follows: —

Normal temperature, 9 P.M., 101.1; 8 A.M., 103; 10 A.M., 103.2; 11.30, 104.3; 1 P.M., 106.2.

The note on this cow is as follows: —

This cow is in good condition, does not cough; but, although she has been served by different bulls, she has not been got with calf. G. N. K.

This morning from ten o'clock until noon she was suffering from rigors.

Another and most important part of the experimental work has been the work done during the past year by Prof. Theobold Smith at the Bussey Institute. When the office of the Board was moved from Village Street to the Commonwealth building, the laboratory was abandoned and

special arrangements were made with Dr. Langdon Frothingham, at the Harvard Medical School, to do such microscopical work as was found to be necessary. (For Dr. Frothingham's report, see page 557.)

The Board was also anxious to have some original research work done. They felt that it would be well to take up some of the questions in relation to tuberculosis that were still unsettled, and endeavor to throw some further light on them. In this matter the Board had the good fortune to secure the co-operation of Prof. Theobold Smith, and they desire to thank him at this time for his generosity in placing his services at their disposal. The cost of buying and keeping the cattle has been defrayed by the Board, the remainder of the work having been done by him free of charge.

For some time there has been a feeling in certain quarters that it was a serious question whether human and bovine tuberculosis were really identical. There was a dearth of information on this matter, and it was felt that further work should be done in this direction. Consequently Dr. Smith's promise of co-operation was received with a great deal of satisfaction. (For the full report of Dr. Smith's work, see page 564.)

The final results and conclusions drawn by Dr. Smith from his work make it by far the most important work of the year. The report is summed up as follows: —

Leaving these aside, the remaining parts of the test appear to me to be of sufficient uniformity and accuracy to justify us in drawing certain preliminary inferences. We may now maintain that bovine tubercle bacilli and human bacilli as found in sputum are not identical. The difference in their action upon cattle is reinforced by certain differences in the bacilli themselves and their effect upon rabbits, as will be detailed in a fuller report.

What the significance of these divergencies is, what influence they have upon the transmissibility of the disease from cattle to man, we are unable at present to state with any degree of certainty. That they do have some effect must be admitted, in view of results of studies upon other species of pathogenic bacteria. Their precise bearing needs careful investigation.

These studies will, I think, warrant one inference, however; that is, that human sputum cannot be regarded as specially

dangerous to cattle, nor can it be looked upon as a factor in the introduction of tuberculosis into a healthy herd of cattle. Even if the tubercle bacilli of cattle and of man are very closely related and have the same ancestry, as we all must admit, if we regard the two as mere varieties, which may eventually under very favorable conditions pass one into the other, the condition in which the bacillus leaves the lungs in sputum is evidently such as to interfere, *under ordinary circumstances*, with any development in the bovine body. It would fall a speedy prey to destruction.

It is interesting to notice that this work of Dr. Smith's confirms the conclusions arrived at by Dr. Frothingham a year ago. In last year's report, page 57, Dr. Frothingham says: —

From these facts we are certainly justified in concluding that calves are apparently not particularly susceptible to the human tubercle bacillus; but whether this non-susceptibility is due to a bacillus of diminished virulence for the bovine, or to the age of the animals experimented upon, or to some other cause, further experiment must demonstrate.

While it may be conceded that bovines are not susceptible to human tubercle bacilli from sputum, yet it by no means follows that human beings are therefore not susceptible to that of the bovine. At the same time, the great danger of the use of the milk and flesh of cattle suffering from tuberculosis has undoubtedly been greatly exaggerated, for the reason that human tuberculosis has been steadily decreasing during the last thirty-five or forty years, while the bovine tuberculosis has undoubtedly increased during the same period.

It cannot be denied that cows with tuberculous udders or that are extensively diseased, even though no lesion can be detected in the udder, give tubercle bacilli in the milk; and, until it is clearly demonstrated that these bacilli are harmless to the human race, such animals must be looked upon as dangerous to the public health.

From the flesh of tuberculous animals there is much less danger than from the milk, as in this community meat is, as a rule, sufficiently well cooked to destroy the vitality of these germs; while, on the other hand, it is customary to use milk in an uncooked condition. In fact, the danger

from meat is really more from bacilli that may be smeared upon its surface from butcher knives that may have come in contact with tuberculous lesions or infected lymphatic glands than from the flesh itself, as it is doubtful if the muscles ever contain the germs of tuberculosis; but, even if the bovine tubercle bacilli were harmless to the human race, it is not a pleasant thought to contemplate using the milk and meat of animals affected with a disgusting and loathsome disease as food for the people of an intelligent, educated and civilized community.

Considered from a public health point of view, the local inspection work would seem to be sufficient for its protection at the present time, if done in an intelligent and painstaking manner. This is an important work, and on general principles, if for no other reason, it would not seem to be advisable to keep these advanced cases, or cases of tuberculosis of the udder, in the dairy. In fact cows with nodulated udders should be considered as unfit animals for milk production, as such udders, when not tuberculous, may be infected with actinomycosis or pus-producing bacteria, either of which should be looked upon as dangerous.

In this direction the local inspectors seem to have been doing good work, judging from the smaller proportion of cases of advanced generalized tuberculosis that have been found during the year, as compared with previous years.

In removing the animals that are quarantined by the local inspectors year after year, picked out as diseased on physical examination, there is no advance to speak of in diminishing the prevalence of tuberculosis among cattle, as a crop of slightly diseased ones are left behind, which in time may develop the disease, so that the succeeding year an equal number will be condemned; and this may be carried on year after year, to infinity, unless something more than this is done.

This may be accomplished in various ways: first, our cattle owners must be educated to pay more attention to the sanitary surroundings of their stock; they should be taught, if possible, to keep only healthy animals under the most healthful surroundings. Those who take pride in their cattle should strive to keep a herd that will not react to the

tuberculin test, and to buy only animals that have been tested with tuberculin.

The funds appropriated by the State for the eradication and control of contagious animal diseases should first be used for the regular work of the Board, including the expenses attendant upon the taking of such cattle as are found to be diseased which the local inspectors have quarantined. If, after this is done, the Cattle Commissioners have sufficient funds at their disposal, what is known as "voluntary request work" should be done; that is, the Cattle Commissioners may test an entire herd at the owner's request, provided he agrees to buy only tested cattle after those that react are removed, and will also agree to thoroughly disinfect his stable as directed by the Board, and take all such other measures to keep his herd free of the disease as may be recommended.

In doing such work, care must be taken to choose only such farms as have buildings that can be thoroughly disinfected, or where the owner has a new barn into which he wishes to move a herd which suffered from this disease in the old barn. There are many New England farm barns that it is almost impossible to disinfect; here, voluntary request testing is of no value. The owner must either pay more attention to hygiene and cull out the bad cases from time to time, or, if he wishes to entirely eradicate tuberculosis from his herd, he must decide to build a new stable.

A single test is not always sufficient to remove all the diseased animals; hence, a second should follow the first within two or three months. The applicant must understand that it may be necessary to repeat the test, and to repeatedly disinfect in order to have the work successful, and that this requires intelligence, patience, perseverance and some expenditure of money.

There are two sides to the question of dealing with bovine tuberculosis, — one is its bearing upon the public health, the other is that it is an insidious, slow-developing, infectious disease of the bovine, yearly inflicting considerable pecuniary loss upon the dairyman and stock breeder. It has been allowed to continue its ravages unnoticed and unchecked for many years, until we have awakened to the fact that our herds are

widely infected with it; and steps should be taken to reduce it to a minimum in a reasonable and economical manner, in order that the public at large may receive milk as far as possible from healthy animals, and the farmers be protected from pecuniary loss.

The disposal of the carcasses of diseased animals is an important matter. Sections 10, 11 and 15, chapter 491 of the Acts of 1894, provide that the carcasses of diseased animals shall not be used for food. Section 37 gives a list of diseases to be deemed contagious under this act, tuberculosis being among the number.

The Board of Cattle Commissioners has always construed this law to imply that the carcass of an animal infected with tuberculosis, no matter how slight or how localized the lesion may be, is not to be used for beef, but must be either rendered or buried.

This appears to be an extravagant and wasteful ruling, as there does not seem to be any well-grounded objection to the use of the meat from very slightly diseased animals. For instance, a beef may have a tuberculous mediastinal, or bronchial lymphatic gland, no larger than the end of a man's thumb, or even no larger than a pea, and be perfectly healthy in other respects; and yet, under a strict construction of the Massachusetts law, that animal must be rendered or buried. Dr. Theobold Smith makes a division of tuberculous animals into two classes, "*infected*" and "*diseased*." The "*infected*" are those having some slight local glandular lesion, yet enjoying perfect health in other respects. The "*diseased*" are those having more or less well-marked lesions in various organs and glands of the body. The saving would perhaps be more upon animals killed in slaughter houses in condition for beef than among cows killed by order of the Cattle Commissioners, for as a rule milch cows are not in beef condition; at the same time, it must be borne in mind that the local inspectors are apt to have slight lesions escape their notice when a cow is killed for beef, but if a cow is tested with tuberculin, she is hunted from the tip of her nose to the tip of her tail, until the nodule or nodules that caused the reaction are found.

In Germany, France and Great Britain it is the usual

practice to pass as sound all meat from animals in which the lesions are slight or localized; where the disease is general or the carcass emaciated, the meat is destroyed. In this country the United States inspectors of the Bureau of Animal Industry, stationed at the large abattoirs where animals are killed for export or interstate commerce, do the same thing; where the disease is localized, the meat is considered sound; and when the lesions are extensive or generalized, the meat is condemned.

This is an important economic problem, and the propriety of so modifying our State laws regarding the disposal of the products of animals infected with tuberculosis as to have them conform to the rules and regulations of the United States Bureau of Animal Industry for the inspection of meat, should be carefully considered.

Another recommendation for carrying on the work at a less cost has to do with the advisability of reducing the rate of compensation for animals condemned as tuberculous by the Board. In the report of the special joint committee appointed by the last Legislature to investigate the killing of certain cows from Dracut and Lowell, last spring, condemned by the tuberculin test of private veterinarians, the majority of the committee reported as follows: —

> From our observations at the investigation, we hold that the Board of Cattle Commissioners should at once take into consideration modifications of the law relative to the condemnation of cattle by tuberculin test alone, — that is, upon the request of owners of cattle for such testing of their herds. If cattle are to be condemned, or regarded as suspicious animals only after they show signs of disease, it is a question as to the propriety or equity of the State paying full value for those that are actually diseased. This proposition we respectfully refer to the consideration of the next General Court, trusting that the Board of Cattle Commissioners will, in the mean time, consider the same question and offer recommendations in their annual report.

In endeavoring to comply with this request, the advisability of any longer paying full compensation must be seriously questioned. The present law provides that full appraised value not exceeding sixty dollars be paid for cattle

killed as tuberculous; "that, whenever any cattle condemned as afflicted with the disease of tuberculosis are killed under the provisions of this section, the full value thereof, at the time of condemnation, not exceeding the sum of sixty dollars for any one animal, shall be paid to the owner thereof out of the treasury of the Commonwealth, if such animal has been owned within the State six months continuously prior to its being killed; provided such person shall not have, prior thereto, in the judgment of the Cattle Commissioners, by wilful act or neglect, contributed to the spread of tuberculosis; but such decision on the part of the commissioners shall not deprive the owner of the right of arbitration as hereinafter provided." (Section 45, chapter 491, Acts of 1894, as amended by section 10, chapter 496, Acts of 1895.)

This is a very delicate question, and one requiring to be handled with the greatest care. In many instances it is found that from some localities certain names appear upon our books more frequently than any other persons, seeming as though special individuals found it profitable to buy suspicious cows and sell them to the State at an advance on the purchase price.

Then, again, certain farmers last spring employed veterinarians to test cattle, with the idea, in many instances, of selling unprofitable cows to the State, and using the money to buy new ones that had not been over grained and milked out, leading to passage of act to prevent owners receiving compensation for cows, etc.

No person having animals tested with tuberculin shall be entitled to compensation from the treasury of the Commonwealth for any animals that react to the tuberculin test, unless such testing be done by the State Board of Cattle Commissioners, or their authorized agents acting as such at the time of the test; and such testing shall be subject to the supervision and control of the State Board of Cattle Commissioners.

Furthermore, local inspectors quarantine cows on suspicion that show no physical evidence of disease, which react to tuberculin, are killed and found to have some slight lesion. The owner puts a new cow in place of the old one, that may not be free from tuberculosis, or, if she is, may in six months

be diseased to the same extent (or more) as the old one, if he has neglected to disinfect the place where the old one stood, or has been careless about it. This would not be the case in any of the above instances, if compensation were not paid in full.

The wisdom of paying full compensation for cattle that react to tuberculin is doubtful, except perhaps in cases where an owner is compelled to have his whole herd tested. If partial compensation only were paid, fewer cattle would be killed by the commission, and at a less proportionate cost to the State, giving more opportunity to test herds for owners who wish to eradicate tuberculosis, which our funds do not allow us to do now. Moreover, there would be no applications, under reduced compensation, for voluntary request tests, except from those who were sincere in their desire to eradicate tuberculosis from their herds, as part of the loss would fall on the cattle owner, and he would not be willing to incur his share of the loss unless he was honest in his wish to rid himself of this disease, which Professor Walley enumerates as one of the "four bovine scourges."

Scientists in various countries have been working for a number of years, and still are, to discover an immunizing or curative agent for tuberculosis; and it is possible that in time, perhaps in a few months and perhaps after the lapse of several years, a material may be produced with which cattle may be rendered immune from tuberculosis, or that even tuberculous cattle may be cured. When these discoveries are made, it will certainly be the duty of the State to avail itself of them. Under the present law, the Cattle Commission has power to create quarantine stations and to experiment with animals in the study of contagious diseases; hence it would seem that the Board has discretionary power to change its methods with the advance of modern scientific research. Meantime, we have tuberculin as a fairly reliable diagnostic agent; it should be used to verify the diagnosis on cattle condemned as tuberculous on a physical examination; and where owners of herds are desirous of eradicating this scourge from among their cattle, we know it can be done where the test is applied two or three times, and the owner complies with the laws of hygiene and has a barn that can

be properly disinfected. We also know, from Bang's experiments, that when a breeder exercises intelligent care it is possible to raise a healthy herd from a diseased one, and in the mean time much can be done in an educational way to improve the existing conditions.

Ordinarily, for the transmission and development of tuberculosis among dairy cattle long and intimate association is required. This close and intimate association of the diseased with the healthy is a condition that commonly exists on the average New England farm, the frequency and seriousness of the infection depending on the amount of infectious material present and on the susceptibility of the different individuals in the barn.

When an animal inhales the dust containing the tubercle bacilli, the bacilli are absorbed through the mucous membrane lining the air passages, and usually find lodgement in the bronchial or mediastinal glands. The presence of the bacilli in these glands, or the constant reinfection from the introduction of new bacilli, stimulates the cells immediately surrounding the bacilli, and the result is that a nodule, or tubercle, is formed. The disease may not go any further until from some cause the resisting power of the animal is weakened; the disease may then develop, and the animal finally falls a victim to tuberculosis. That this is ordinarily the course of the disease is borne out by the fact that in by far the larger number of cases the thoracic glands are found to be the initial seat of the disease, and frequently on post-mortem examination the animal is found to be only very slightly infected. Under such conditions it follows that every precaution should be taken to prevent the development of these slight localized cases, and anything that tends to undermine and weaken the health of the animals should be avoided.

In attempting to prevent the spread of the disease, one of the most important matters to be attended to is to endeavor to reduce the amount of infectious material present in the barn, for of course the greater the amount there is present the greater the likelihood that the cows in that barn will become infected; and, in endeavoring to reduce the quantity of this infectious material, it should be recollected that disinfection

and washing are not the only methods that should be adopted.

When a ray of light penetrates a dark room, innumerable particles of dust may be seen floating in the air; these particles of so-called dust are organic matters given off by the occupants of the barn, as well as fungi, bacteria and particles of hay, grasses, etc., which make good carriers for the various forms of bacteria; and it is this dust that is so dangerous as a source of infection in tuberculosis.

This can be better realized, perhaps, when it is pointed out that the manure is, and must be considered, one of the dangerous factors by which the disease is spread in the stables: it very frequently contains the tubercle bacilli, and when it dries it becomes pulverized and powdery, and along with the discharges from the nose it mixes with the dust and chaff, and when stirred up it is carried in the air and is breathed by the cattle, which are frequently kept tied in the barn all winter long without any form of exercise. Under such circumstances the circulation naturally becomes sluggish, less oxygen is required by the body, the breathing becomes shallow and the lungs are not expanded; and when any extra strain is put upon them they are unable to do their work, and we have rupture and permanent dilation of the air cells, along with weak lungs and a predisposition to pulmonary disease. In other words, we have just the condition most suited to the development of tuberculosis, and at the same time the animal is breathing an atmosphere impregnated with infectious material.

Bearing this in mind, then, one can readily see how important it is to thoroughly ventilate the barns. When the hot, foul, infected air is continually being diluted by fresh outside air, of course the continual dilution lessens the proportional amount of infectious material in the air, and therefore lessens the danger from its inhalation; and not only is there less danger from infection, but the health of the animals is better. When only a small quantity of Co_2 is contained in the air, the Co_2 in the lungs is very readily diffused through the atmosphere; but when that atmosphere has become impure, when it contains a large quantity of Co_2 with organic impurities, then the Co_2 in the lungs is not so

readily diffused through the air; it sooner finds its level and is retained in the system, where, from want of oxygen, the vitality is lowered and the dulness and lethargy experienced such as is felt by any one after sleeping all night in a close room.

Most farmers that object to the admission of fresh air in their barns do so because they say that cold barns and cold draughts blowing on the cattle will check the flow of milk; but it is not necessary to have these cold draughts. Judgment must be used to see that the admission of the fresh outside air does not cause draughts; the volume of the incoming air should be broken up and evenly distributed through the barn, so that currents of cold air and draughts are avoided. The question of the absolute necessity of good ventilation and pure air, and its influence on health, is not merely a theoretical one, but, as will be shown later, its immense influence on health and disease can easily be demonstrated.

The want of drainage and the presence of dark and damp cellars under the barns is another matter that bears a close relationship to the warmth and comfort of the barn. The cellar is usually dark and damp; the sun never shines there, and either the drip from the floor above or the surface drainage from the yard keep it in a continual state of moisture. This continual dampness below the barn is in a great measure responsible for the cool, chill feeling that one often feels on entering a barn. The cellar is never drained; it dries only by evaporation, and the feeling of chill that one experiences is a direct result of the warmth being used up in the work of evaporation. One hardly realizes what this amounts to; but we are told by Professor Kedzie (New Hampshire Board of Health report, 1893, Vol. II.) that: —

To evaporate one pound of water consumes enough heat to raise the temperature of five and one-half pounds of water from freezing to boiling point; or, to vary the illustration, suppose that a tile drain discharges constantly for one day a stream of water whose cross-section is one square inch and velocity two and one-half miles an hour, — this *one day's drainage* alone would save the heat equivalent to nearly six tons of coal.

Further, we must remember that barns are usually warm; this warmth causes a current of air upwards, so that this damp, chilly air is drawn up into the barn above, where it does the most harm. In referring further to damp surroundings, Professor Kedzie again forcibly remarks: —

The *evaporation* of so much water renders the air over such a soil damp and chilly. The result is a physical necessity. This damp and chilly atmosphere has a more serious result than the simple feeling of discomfort. It has a most depressing influence on the human system, lowering its tone, enfeebling the vital powers, and acting as the predisposing cause of a long list of diseases, some of them the most destructive and incurable known to the medical profession. The depressing influence of the dampness and chilliness of a water-soaked soil is not to be compared to the effect of an occasional wetting, as when we are caught in a shower. The chilly dampness of the undrained soil is persistent and unremitting, dragging us down with its cold fingers at all hours, at "noon of day and noon of night," as if we toiled and rested, waked and slept in a perpetual drizzle of cold rain. It may seem a small force at first, but its persistent, untiring and relentless pull tells upon the strongest at last, like the invisible fingers of gravity which finally drag down all to a common level. This depressing influence is not developed suddenly and distinctly, but silently and secretly the sapping and mining go on, till the explosion comes in sickness, suffering and the sleep that is eternal.

If it is necessary to have cellars, then it is necessary that the floor of the stable should be water-tight; that the cellar should be well lighted and ventilated; that both cellar and subsoil should be well drained; that the manure, instead of being dumped into the cellar, should be taken some distance from the barn, and the liquid taken up by absorbents or carried to a cesspool, where it can be made use of, instead of going to waste by soaking into the subsoil below the barn.

Light is another essential in the thorough disinfection of barns that is too often neglected. The majority of barns have only one or two small windows, rarely larger than say eighteen or twenty-four inches square, usually thick with dust, and giving a "dim, religious light," or none at all. Only very few barns have windows sufficiently large to give free admittance to the sunlight. Owners of cattle do not

seem to realize that sunlight is just as essential to the health of animal life as it is to plant life. There is no reason why barns should not be as light as dwelling-houses; and the responsibility for its exclusion from barns must rest with the old theorists, who claimed that cattle would fatten and do better when kept in the dark than when exposed to the light. It has seemingly taken a long time for this idea to be abandoned, and even at the present time it seems to be impossible to teach some people that light is not detrimental to the health of dairy stock. It is especially necessary where, through want of fresh air and exercise, the circulation is sluggish and the system depressed.

Light stimulates the circulation, and with increased oxidation more Co_2 is given off and the functions of the whole body are quickened and enlivened; but sunlight also retards the growth of germ life, and the vitality of certain forms of bacteria, *including tubercle bacilli*, is destroyed in a few hours' time by the direct action of the sunlight. Sunlight is not only the best, but the cheapest, disinfectant we know.

In referring to the question of sanitation and tuberculosis, Dr. James Russell, in the report of the Glasgow Board of Health, says that: —

The death rate from "phthisis" has fallen from 2,849 per million to 2,316, and from other tubercular diseases from 1,090 per million to 884, in both cases 19 per cent., — a result which quite casts into the shade the improvement in Prussia and Saxony, quoted from Cornet, which he puts to the credit of special prophylaxis. Clearly, then, we are warranted in asserting that among infectious diseases tuberculosis is the most amenable of all to general hygienic measures; that, in fact, from these alone as good results are obtained as from hygienic measures plus isolation, disinfection, etc., in the case of diseases popularly known as infectious. It is not implied that special measures directed against the infectivity might not have produced even better results; but in view of what has been accomplished, and in view of the difficulties in the way of special prophylaxis, it is contended that more is to be expected from general hygiene.

The New York Medical Record (Dec. 30, 1893), in referring to sanitary conditions in Great Britain, says: —

The average annual death rate throughout England and Wales during the twenty years previous to 1870 did not vary greatly from 22.5 per 1,000 of population; and it was estimated by Mr. Simon that 125,000 persons died each year of diseases due to defective sanitary conditions. Although Simon's figures were thought by some to be exaggerated, they nevertheless had great weight in persuading Parliament to adopt the reforms recommended by him. During the next twenty years extensive improvements were carried out on a large scale, with the result that in 1889 the mortality had fallen to 17.9 per 1,000, thus more than justifying the calculations of Simon.

In referring to this same subject, Prof. F. Smith of Aldershot, in his "Manual of Veterinary Hygiene," says: —

The mortality amongst the horses of the French cavalry was at one time frightful; previous to 1836 they lost 180 to 197 per 1,000 per annum; the air space being increased reduced the losses in the next ten years to 68 per 1,000.

The following table * shows the number of cases of lung and glanders diseases among the horses of the French cavalry from 1847–66, a period of nineteen years: —

	1847-52 Ratio per 1,000.	1853-56 Ratio per 1,000.	1857-61 Ratio per 1,000.	1862-66 Ratio per 1,000.
Glanders, ...	23.32	21.44	10.97	7.24
Inflammation of lungs and pleura, . . .	104.7	110.6	45.8	3.59

This table shows that in nineteen years a reduction of 16.08 per 1,000 had occurred in cases of glanders, and no less than 101.11 in cases of pneumonia and pleurisy. These wonderful results were obtained through the labors of a Commission of Veterinary Military Hygiene, which pointed out the necessity of the ventilation of stables, increased cubic capacity and attention to sanitation, feeding and general care. The practical outcome of these results was that a saving of £90,000 per annum was effected in the purchase of horses alone.

* Copied from a most interesting and valuable paper on "The Vital Statistics of Cavalry Horses," by Dr. Balfour, F.R.S., "Journal of the Statistical Society," June, 1880.

The only explanation of the great difference in the mortality is the larger amount of pure air supplied, and the better ventilation of the stables.

And again, in the report of the State Board of Health of New Hampshire for 1892, in speaking of this matter, it says: —

There is no doubt of the great mortality from consumption in persons living in badly ventilated rooms. A few years ago the proportion of deaths among the soldiers of European armies from this cause was very high; but now, owing to better ventilation, the other conditions remaining the same, the percentage has greatly fallen. In one regiment in England, when the barracks were not ventilated, the death-rate for lung diseases was 12½ per 1,000; but after efficient ventilation had been introduced it fell to 1½ per 1,000.

Parkes gives a similar example from two hospitals in Vienna. In one, very badly ventilated, of 4,280 prisoners, 220, or 51.4 per 1,000, died of consumption; of these, 42 of galloping consumption. In the well-ventilated hospital, of 3,037 prisoners, 24 only, or 7.9 per 1,000, died of the same disease. The conditions in the two hospitals, excepting ventilation, being alike, the badly ventilated one had six and a half times as many deaths from this cause alone as the better-aired one.

The statistics collected by Dr. Buchanan on this subject are also instructive: —

In Salisbury, England, after the introduction of improved drainage, the annual death rate from phthisis fell from 44½ per 10,000 to 22½ per 10,000 between 1857 and 1864. In the same period of time, in the towns of Ely, Rugby, Worthing, Macclesfielf, Leicester, Newport and Banbury, the death rate from phthisis fell 47, 43, 36, 51, 52, 52 and 50 per cent., respectively, in consequence of improved drainage alone.

The importance of this matter is also shown in the report on the experimental work by Ernst and Peters, at Mattapan, where, in referring to the effect of improved sanitary conditions on diseased cows, it says: —

Before the farm buildings were used at all, they were thoroughly cleaned from top to bottom. Every portion of old manure was carted away, as well as all the old earth. The whole of the wood-

work was scrubbed and then washed with corrosive sublimate solution (1.1000) and finally whitewashed, and every care taken to secure good drainage and ventilation. The result and effectiveness of all this have been best demonstrated by the fact that every animal brought to the place made a most marked improvement in its general condition, while some of them even went so far as to appear to get well. (Ernst.)

The same thing is shown in the case of some cattle at Mr. French's farm at North Andover, where several animals were slaughtered after testing with tuberculin; a number of the remaining animals that reacted to the tuberculin test were turned out to pasture, and in the fall they were brought in and retested by the State authorities, and they failed to react, the recovery evidently having resulted from the open-air life in pasture during the summer months.

A similar incident is related by Professor Law. He says: —

In 1877 I recognized the existence of tuberculosis in the Jersey herd of Burden Bros. of Troy. The worst were slaughtered, but some incipient cases in young animals were turned out in a pasture by themselves, where they passed the summer in apparently robust health, but they began to droop when returned to the barns in the fall. (Paper by Prof. James Law, read at Peterborough, N. H., December, 1892.)

These are only a few of the examples showing the great influence that the surroundings have on the health of the animal body; pages of statistics could be quoted and figures given showing the same results, but that would only be an unnecessary repetition, as the immense importance of good sanitary and hygienic conditions is generally accepted by every one.

In suggesting improvement on the present method of constructing dairy barns, cheapness of construction and convenience in handling, as well as the health of the stock, have been borne in mind. Of course these ideas can be elaborated or modified according to the wealth of the owner and the amount of money to be expended on the buildings; but, whether the cost is to be great or small, it is absolutely necessary, if the health of the cattle is to be maintained, that there should be pure air and good ventilation, as well as

sunlight, drainage and dryness in and around the farm buildings.

In building new barns, many progressive farmers have adopted the idea of using the old barn for storage purposes, and stabling the cattle in a one-story building or shed adjoining. This arrangement admits of many advantages; it is more easily ventilated and lighted, it has no cellar, the hay and food is not contaminated with the odor from the cattle, and it is an economical form of construction and can be erected at comparatively little cost.

Among the more expensive examples of this form of construction may be mentioned the cattle barn at the Lyman School for Boys, at Westborough. The cow stable at the Millwood Farm, Framingham, is another good example of this form of barn. It is unusually well lighted and ventilated, and simple in design and construction.

In making calculations as to the amount of cubic space required for each animal, we should remember that each cow uses approximately 1,000 cubic feet of air per hour. Now of course, if the barn admits of each cow having 1,000 cubic feet of air space, then the air in the barn will need to be renewed each hour; and of course, if the air space provided is less, then correspondingly the supply of fresh air will need to be more frequent; but where the cubic space is greater, the supply may be less frequent. The problem, then, is to carry away the foul, impure air, and to supply each animal with 1,000 cubic feet of fresh air each hour in such a manner as not to cause a draught on the animals. To do this, the air must not be admitted in bulk, nor must it move at a greater speed than 3 feet per second, — in fact, the slower and more imperceptibly it moves into the barn, the less draught will there be.

Many farmers attempt to admit fresh air by keeping door or windows open; the result is that a body of cold air finds its way in and falls directly on the back of the cattle; the cattle stand and shiver, and curl up, look miserable, and fall off in their milk; and the farmer is discouraged, and makes up his mind that fresh, cool air does no good to the cattle, but rather does harm, and he won't admit any more than he can help. To prevent such a condition of affairs, and to

keep draughts from the cattle, fresh air should either be admitted high up, or should be directed upwards so as to become tempered before it falls. By directing up toward the ceiling, by admitting it in small openings, and by breaking up draughts and currents of air by louvre boards, air will be diffused through the building, and large quantities of air can be admitted without causing any appreciable draughts or other ill effects.

A good method of introducing fresh air is by wooden pipes or boxes placed below the floor opening outside, and having the external opening screened to keep out the dust. These should communicate with upright boxes opening well up in the barn, the opening directed upward and broken up with louvre boards, or screens, or netting at the top to break up the current of air and distribute it.

Ventilators, or openings for the foul air to escape, should always be at the highest part of the roof. The openings should be protected so that the wind will not blow down and check the upward current of foul air, but the wind should be utilized so as to cause a partial vacuum on the lee of the building, or ventilator; the vacuum thus caused will have a tendency to suck the foul air up and out of the barn. Thorough ventilation is of course much easier to accomplish when the building is heated by artificial means; but by taking advantage of the wind and the natural warmth of the barn, much can be accomplished even without artificial heat.

One of the best points in the Millwood Farm buildings is the good window space. In building barns, owners should remember that they cannot have too much light, and windows do not add enough to the cost of the building to counterbalance their great benefit.

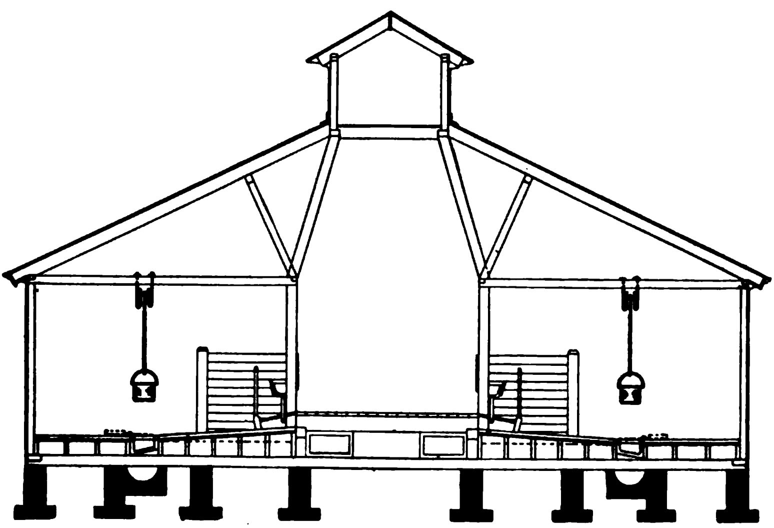
A practical point in the arrangement of this barn is placing the calf pens next the window, and in this way protecting them from being broken by the horns of the passing cows.

The floors, and especially the manure gutter of barns, should always be tight; otherwise the liquid manure will saturate the floor below the barn, besides wasting a valuable fertilizer. As a matter of economy, if for no other reason, arrangements should always be made either for the absorption of the liquid portion or for carrying it to a tank or

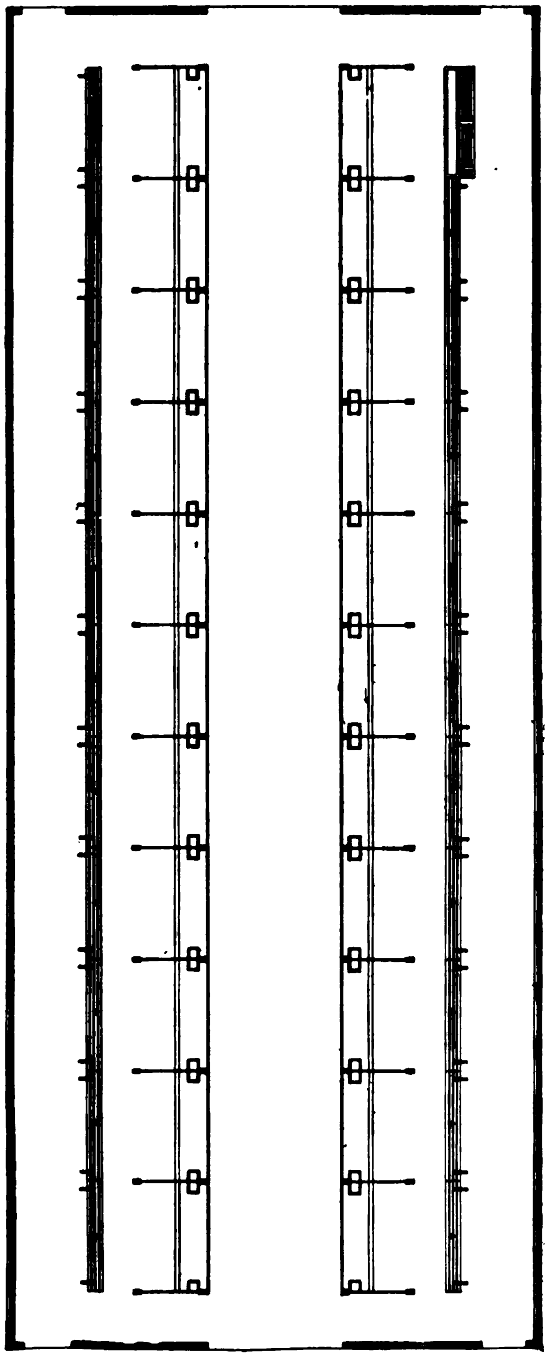
cesspool, where it can be stored until drawn off and spread on the land.

In presenting the following sketch of a cow stable, it has been the purpose of the Board to submit ideas of a stable

which is adapted to most of our Massachusetts farms; and, while it has been our intention to leave out nothing that enters into the comfort and healthfulness of the animals, we



have aimed at a building of small cost, in which it is possible to handle the herd with economy. On most of our farms the stable can be built onto the end or side of the present



barn, thereby utilizing the old barn for storage of fodder, and also using the cellar under the old barn, if there be one, as a dump for the manure. The plan provides for a drive through the centre of the stable, for purpose of feeding; for raised cribs adjoining the floor or feed walk, whereby a herdsman can not only have his eyes on the feeding of every animal, but he will feed and clean the cribs of forty cows in such a stable easier than five where fed in box cribs, and do it more perfectly and easily, and his work can be inspected at a glance; for a self-watering device, giving the advantage of having a constant supply of water before the cattle at all times; for a slanting manure gutter, in which the cows will seldom stand; for a stable which is very light and well ventilated.

Texas Fever.

During August a number of cases of Texas fever occurred, thirty-five head of cattle dying that were reported to the Board of Cattle Commissioners, with the possibility of a few other animals having died that were not reported to the Board. These cases were confined entirely to three carloads from New York State, as follows: —

On August 2, E. N. Smith of Watertown brought a carload of nineteen cows from Herkimer County, New York, of which number thirteen died within fifteen days of Texas fever. These animals were sold to different parties, and went out into the country into herds owned by the following persons: –

C. A. Dennen, Pepperell,	2	
Jonathan Davis, Sterling,	1	
Mr. Lumnie (sold to McGowan), Dedham,	3	
Mr. Horton, Fall River,	3	
W. J. Navell, Lexington,	1	
A. S. Gushee, Dorchester,	1	
Cash (name of purchaser not known),	1	
George Durth,	1	
		— 13

On August 9, Geo. N. Smith of Watertown brought a load from Jefferson County, New York, consisting of seventeen cows and one bull. Of these, the following animals died, bought by persons whose names are here given: —

C. A. Dennen, Pepperell,	1	
E. B. Wilbur, West Bridgewater,	3	
Walter Dennis,	1	
Wm. Bowen, Providence, R. I.,	2	
	—	7

All of these died within fifteen days from the day they were landed at Brighton.

On August 16, Geo. N. Smith brought another carload of twenty-two cows from the same place. Of these, fifteen died; two others were very sick, but have partially recovered. These were bought by: —

H. E. Eames, Framingham,	7*	
J. Berry, Cambridgeport,	1	
Warren Davis, Needham,	1	
John Swinerton, Danvers,	2	
J. S. Henry, Watertown,	5	
	—	15
		—
Total,		35

The loss of these animals and the source of their infection seemed to the members of the Board to be so serious a matter that it was decided to employ a special agent, having expert knowledge of this disease, to investigate this outbreak, and make a full report concerning it.

The services of Dr. Cooper Curtice of Moravia, N. Y., were secured, he being a former employee of the Bureau of Animal Industry, United States Department of Agriculture, and having had an extensive experience with Texas fever and a broad knowledge of its cause and mode of extension. Dr. Curtice commenced his labors for the Board of Cattle Commissioners September 18, and brought them to a close on October 9, making his report with the following letter of transmittal October 11: —

MORAVIA, N. Y., Oct. 11, 1897.

DR. AUSTIN PETERS, *Chairman, Massachusetts Cattle Commissioners, Boston, Mass.*

SIR: — I send by this mail my report on the outbreak of Texas fever in your State. I have included some remarks upon the pre-

* 6 died.

vention of future outbreaks. While they seem to reflect strongly upon the management of the United States Bureau of Animal Industry, I trust that the presentation of the facts will not only enlarge the present duties of these United States officers, but call the attention of your State and others to the need of more careful work being done by them. Public officials often fail to do what they themselves deem right, because of failure of funds and a public opinion that will sustain them in their action.

I am, very respectfully, yours,

COOPER CURTICE,
Veterinarian.

The history of the source, transportation, distribution and subsequent deaths of the cattle concerned in the outbreak in eastern Massachusetts, obtained mainly through the efforts of Commissioner Dennen, is as follows: —

First Carload. — Mr. E. N. Smith of Watertown, Mass., bought nineteen cows in Herkimer County, New York, from five different men, as follows: –

Will Cotter, Little Falls, N. Y.,	9
A. L. Eaton, Little Falls, N. Y.,	6
V. Farrell, Newport,	1
James Moone, Coldbrook,	2
James Doyle, Newport,	1
	19

These were shipped from Herkimer, N. Y., consigned to Brighton, Mass., in a Rome & Watertown car No. 10028. They arrived at West Albany stock yards on Sunday, August 1, where they were unloaded to be fed and watered, and driven into pen 16, alley D, for a few hours. They were then reshipped to Brighton stock yards, where they arrived Monday night, August 2. They were driven into pens 11 and 13, Texas alley, and thence into pens 34 and 35, thence they were released and distributed to the surrounding country. Thirteen head out of the nineteen thus handled died soon after. One cow died on August 11, one on August 12, three about August 14, one on August 17, and one on August 20.

Second Carload. — Mr. Geo. N. Smith of Watertown, Mass., bought seventeen cows and one bull in Jefferson County, New York, from thirteen farmers, as follows: —

Rush Pennal, Pamelia, N. Y.,		1
Mr. Zimmerman, Pamelia, N. Y.,		1
C. Klock, Pamelia, N. Y.,		1
Wm. Reese, Evans Mills,		2
D. A. Rich, Watertown,		1
Wm. Weale, Watertown,		1
Charles Hawley, Ellisburg,		2
George Butts, Ellisburg,		2
Mr. Scott, Ellisburg,		1
John Eastman, Ellisburg,		1
A. O. Davis, Ellisburg,		1
Mr. Griffin, Rutland,	1 bull,	2
Charles Ferguson, Rutland,		1
	1 bull,	17 cows.

These were shipped from Watertown, N. Y., consigned to Brighton, Mass., in Rome & Watertown car No. 10033. They arrived in West Albany stock yards on Sunday, August 8, where they were unloaded and driven to pen 16, alley D. After a few hours they were reshipped to Brighton stock yards, where they arrived Monday night, August 9, and were driven into pens 11 and 13, Texas alley; thence into pens 34 and 35, to be distributed to the surrounding country. Of these eighteen head, seven died: two on August 18, one on August 22 and two others about the same time.

Third Carload.—Mr. Geo. Smith bought another carload of cattle, consisting of twenty-two cows, from twelve different farmers in Jefferson County, as follows:—

Mr. Colon, Cape Vincent, N. Y.,	1
"Abe," Cape Vincent, N. Y.,	2
Mr. Vincent, Cape Vincent, N. Y.,	3
Mr. Walker, Cape Vincent, N. Y.,	2
Louis Ives, Freed settlement,	1
W. R. Smith, Antwerp,	4
David Taylor, Antwerp,	1
Mr. Mason, Antwerp,	1
Wm. Umpstead, Freed settlement,	4
D. A. Rich, Watertown,	1
John Leahr, Dexter,	1
L. Hill, Dexter,	1
	22

These cattle were shipped from Watertown, N. Y., consigned to Brighton, Mass., in a New York Central car No. 23897 or 23015. They arrived at West Albany stock yards Sunday, August 15, where they were driven into pen 17 D. After being rested, fed and watered, they were reshipped, and arrived in Brighton Monday evening. They too were driven into pens 11 and 13, Texas alley; thence into pens 34 and 35, whence they were distributed. Of these, fifteen died: three before August 27, six before August 31, and two recovered.

The above three carloads of cows were all that have been reported as having been affected with Texas fever, that were distributed in eastern Massachusetts.

The diagnosis of Texas fever in the dead cattle has been made on the following data: —

1. Specimens of spleens and kidneys of two cows, owned by Commissioner Dennen of Pepperell, were examined by Dr. Frothingham, pathologist to the commission, and the micro-parasite (*Pyrosoma bigeminum* Smith), the cause of the disease, was found. This diagnosis was confirmed by Dr. Theobold Smith, pathologist of the Massachusetts State Board of Health, the original discoverer of the cause of the disease. Mr. Dennen lost three cows.

2. Specimens from a cow owned by Mr. Eames of Framingham, Mass., and submitted by W. P. Mayo, also yielded the micro-parasite upon examination by Dr. Frothingham. Mr. Eames lost six cows; one other was sick, but recovered.

3. Specimens of spleen from cow owned by James McGowan of Dedham, Mass., and submitted by Dr. G. B. Foss of Harvard Veterinary Hospital, also yielded the micro-parasite to Dr. Frothingham. Mr. McGowan lost three cows of the same disease.

4. Commissioner Dennen secured a full-grown cattle tick (*Boöphilus bovis* (Riley sp.) Curtice), about the middle of September, from one of Mr. Eames' cows that recovered from the disease.

The positive determination by the finding of the micro-parasite in four animals involved in this outbreak, and the finding of the tick on the recovered animal, fully demonstrates the outbreak to have been due to Texas fever.

A fourth carload of cattle, taken from northern New York to western Connecticut, suffered with the disease, and the facts of the outbreak have been gathered in fulfilling your directions on this point. These facts were given by Mr. W. B. Sprague, commissioner on domestic animals, Hartford, Conn., Mr. D. H. Canfield, Bridgewater, Conn., of the firm of Odell & Canfield, the cattle dealers who imported the cattle, and others.

Fourth Carload.—Mr. M. W. Odell of Roxbury Centre, Conn., bought eighteen cows, nine heifers and four calves in St. Lawrence County, N. Y. They were shipped from Norwood, N. Y., consigned to New Milford, Conn., *via* Utica, in New York Central car No. 22931. They arrived at the West Albany stock yards Sunday, August 1, and were driven into pen 15, alley D, to be fed, watered and rested. They remained here until Monday, August 2, when they were reshipped to New Milford, where they arrived Tuesday, August 3. They were then driven to Mr. Canfield's farm, two miles south-east of New Milford. On the 4th of August they were driven to Roxbury, and kept on Mr. M. W. Odell's farm, separate from other cattle. The distribution of these is as follows: —

August 5, H. N. Allen, Pawling, N. Y.,	2 cows, 2 died.
August 5, Wm. O'Brien, Roxbury, Conn.,	1 cow, 1 died.
August 5, Alonzo Whitehead, Roxbury, Conn.,	1 cow.
August 5, Chas. Botchford, Roxbury, Conn.,	2 cows, 1 died.
August 9, G. W. Hurlburt, Roxbury, Conn.,	2 heifers.*
August 16, Anthony Mazotos, Naugatuck,	1 cow.
September 9, C. H. Sanford, Bridgewater,	1 cow.
September 15, Chas Botchford, Roxbury,	1 cow.
October 1, now in lot, Roxbury,	5 cows.
October 1, now in lot, Roxbury,	5 heifers.
Buried in lot,	3 heifers, 3 died.
Buried in lot,	3 heifers, 3 died.

It is thus apparent that, of the twenty-seven head, ten died. One heifer was temporarily sick, but recovered. Mr. Odell found five ticks upon her, each half as large as the little finger nail. A careful search yielded none on October 1, the time of my inspection.

The following notes will indicate the character of the disease, and the post-mortem appearances as near as can be arrived at: —

Mr. O'Brien's cow was taken sick Friday, August 13, and died Sunday night, August 15. She was examined Monday morning. The flesh looked well; the spleen enlarged, soft, pulpy and dark; the gall bladder large, with thickened contents; the kidneys dark, even black; the lungs and heart perfectly healthy; the intestines all right; the bladder full. Mr. O'Brien reported that the cow passed dark-red water while sick.

Mr. Odell's cow calved August 14, and seemed well, but did not come to her milk. She first appeared sick Monday, August 16, and died Tuesday night, August 17. She passed red water on

* Two years old.

August 15. She was examined by Mr. Canfield, Mr. Odell and Dr. R. S. Todd, of New Milford. The symptoms were almost identical with those of the O'Brien cow.

On Tuesday afternoon, August 17, one cow was found dead in the pasture, and two missing. The missing cows were found Wednesday; one was dead, the other sick.

On Thursday, August 19, a three-year-old heifer was examined in the presence of Commissioner Sprague, Mr. Canfield and others. She had the same appearances as the O'Brien and other cows. One cow was observed to be sick August 19, while the commissioner was there. She died Saturday, August 21.

Messrs. D. H. Canfield and H. M. Canfield, South Britain, saw ticks on the Odell cow. They were about the size of wheat grains. Dr. R. S. Todd, veterinarian, of New Milford, Conn., saw the post-mortem of Mr. Odell's cow: "The intestines were empty; the manifolds baked; the lungs and heart normal; the liver and spleen enlarged; bladder filled with black urine; gall bladder filled with cheesy gall."

He also saw two others, which he says were in almost the same condition, but the spleens not nearly as large. They were, however, larger than normal, and dark. One had yellowish cast to liver. The temperature of cows that he took ranged from 105° to 106.4° F. One, an Ayrshire, was sub-normal, 96° F. This cow died that night, after Dr. Todd left.

Mr. Walter Booth, a butcher, opened at least three cows. All had red water in bladder; one had a very soft liver; one had very black gall; the spleen in one was about twice the usual size, others larger than usual.

Though the determination of the cause of death in these cattle is not as scientifically accurate as in the case of the Massachusetts cattle, there is little room for doubt that these cattle also died of Texas fever. The history of transportation through pen 15, alley D, at West Albany, where, as will be maintained hereafter, a carload of quarantine cattle, shipped to New York, June 18, were fed and watered; the clinical development of the disease; the gross post-mortem appearances, as detailed to me by Dr. Todd, Mr. Canfield and Mr. Booth; combined with the finding of ticks attached to cattle by at least three men, — practically decide the diagnosis.

On my return to Albany, Saturday, October 2, another set of facts bearing upon this outbreak, and in line with the above, was brought to my attention.

In the investigation at Albany and in New York State I have had the hearty co-operation of Mr. Charles A. Wieting, commis-

sioner of agriculture, and Mr. G. D. Flanders, assistant commissioner, who detailed Dr. Wm. H. Kelly of Albany, N. Y., to investigate the outbreak for the State. Saturday noon, October 2, Dr. Kelly took me to see a patient in his private practice. A cow owned by the Little Sisters of the Poor was lying nearly dead. She was bought about ten days earlier at the West Albany stock yards, but had been in the stable seven days. She was originally owned by the Shaker Settlement near Albany, and had been around the stock yards for three or four weeks. On the Thursday preceding she had been taken violently ill with chills, and had passed red water. This cow died that afternoon, and, by arrangement made by Dr. Kelly, was post-mortemed at a rendering establishment outside the city.

This cow's muscles were bright, as if partially bled; the lungs were normal, excepting a small area in the posterior portion, which was partially hepatized; the heart was firmly contracted, its muscles being quite pale; the posterior mediastinal and the left bronchial lymphatic glands contained a few one-fifth-inch diameter caseous gritty foci of tubercular origin; the spleen was from three to four times enlarged, with the characteristic blackberry-jam appearance on section; liver much enlarged, with decided yellowish cast; gall bladder full, gall thickened; intestine with reddish or pinkish appearance; kidneys very dark on section; bladder full of dark-red urine; uterus, with black contents, showing the animal to have calved recently.

Cover-glass preparations made from the heart muscles yielded the micro-organism of Texas fever to Dr. Frothingham, October 5. Portions of the heart, liver, spleen, kidney and the entire bladder were submitted to Dr. V. A. Moore, pathologist of New York State Veterinary College, by Dr. Kelly, for examination. A close inspection of the skin discovered a single female tick *Boöphilus bovus*, but little more than two weeks old.

The known details of the transportation and of the outbreak of Texas fever having been given, it becomes necessary to outline the principal features of the scientific history of the disease, that the two may be compared and a working theory advanced to discover the source of disease. This presentation is founded upon the investigations of the scientific force of the United States Bureau of Animal Industry, from 1886 to 1896, and various earlier writers upon this subject.

It has long been known that cattle from the south Atlantic seaboard and Gulf coast States, though seemingly and actually healthy, had the property of infecting the ground whenever driven or transported into mountainous countries or the northern States,

so that native cattle when grazing or resting upon the infected places contracted the disease known to the United States government as Texas fever, but to farmers as " red water," "bloody murrain " or " tick fever."

The actual cause of the disease (the micro-parasite *Pyrosoma bigeminum*, Smith) was demonstrated in 1889. The proof that cattle ticks (*Boöphilus bovis* (Riley sp.) Curtice) carried this disease from one animal to another followed a year or two later.

A complete cycle of an outbreak of this disease is embraced between the time that it leaves an animal capable of infecting ground it passes over, until it destroys or runs its course in an attacked animal.

In their investigations, the Bureau authorities completely demonstrated the fact that southern cattle without ticks were incapable of spreading disease; that young ticks hatched from eggs laid by ticks plucked from southern cattle produced the disease when placed on susceptible northern cattle in from thirteen to twenty-one or more days, depending upon the age of the cattle and the temperature of the weather.

They also demonstrated that blood taken from affected cattle produced disease in young cattle, and death in older cattle in from thirteen to twenty-one days, but on one occasion eight days and on another nine days. It has been demonstrated that the appearance of the disease in northern cattle is entirely dependent upon the life-history of the cattle tick. For example: southern cattle passing through stock yards, riding in cars, driven over highways or pasturing, lose the ticks, which usually infect them, upon the ground. These ticks lay eggs beginning in from one to four days, and continuing a week. Incubation begins at once, and continues, depending mainly upon heat and moisture, from three to six weeks. Since the ovipositing is prolonged, the hatching is also prolonged. After a day or two the recently hatched ticks scatter somewhat and crawl upwards on the grass blades, sticks, or whatever is first met with. They are then ready to attach themselves to cattle, from which alone they can get the sustenance necessary to carry them to maturity. They may endure, however, in this condition for a practically indefinite time, three to four months, unless benumbed by the chilling frosts and the low average temperature of the fall months.

The home of these ticks, the country where they are practically perpetually present, unless eradicated by the efforts of farmers or agricultural processes, is coincidental with the area described above as containing cattle which may carry disease to northern cattle. The tick does not seem to be able to stand climatic con-

ditions of winter north of the thirty-seventh parallel, with few exceptions, certainly not north of the thirty-eighth. *Whenever it is found north of its usual habitat, it is because it or its parents have been transported there by cattle in the course of traffic.*

The facts that must be borne in mind when considering any outbreak in the north, and I might add within the so-called infected territory, are that cattle bearing ticks drop them; from these, young ticks emerge usually in about six weeks in warm weather; and that northern cattle usually die in from two to three weeks after they are attacked. While the time of hatching of ticks is delayed by cooler weather of spring or fall, the above epitome is essentially correct. *The time, therefore, between infection of ground and the destruction of cattle is from seven to ten weeks.*

The determination that certain cattle have died of Texas fever, — a disease that can only be communicated by their having been in places infected by cattle brought from the permanently (so-called) infected area, — points out the direction in which one must search for the source of the disease, viz., to cars, stock yards, etc.

By your direction, Mr. Chairman, I have followed up both negative and positive evidence in this connection; indeed, this has been necessary, for only toward the close of the investigation did the positive evidence present itself. Since the diseased cattle were scattered to farms from the Brighton stock yards, when there was no disease in other cattle with which they mingled, it became evident that they must have contracted it before being separated.

On looking back at the date concerning the second carload lot, it will be seen that cattle died *eight* days after they arrived at Brighton; also that one cow died in *nine* days after in the first carload, and three in the third carload within *ten* days after arrival.

A reference to the experiments relating to the time of death from the disease after ticks have been placed upon cattle show it to be thirteen days or more. My own investigations have shown that deaths have occurred in outbreaks as soon as eleven days after exposure; but this is exceptional. In blood inoculation, where blood was transferred from diseased cattle directly to sound, death in one instance alone was unexpectedly produced in eight days; in another, in nine days. As a rule, the time is about the same as for tick inoculations. It is conceivable, therefore, that the disease might develop within ten days from tick inoculations, but hardly probable. Since the disease broke out in five cases in from eight to ten days after reaching the Brighton yards, infection from those yards is practically excluded. In the absence of positive infection by the proof of southern cattle having been placed in those yards, they must be regarded as uninfected.

The evidence regarding the infection of the Connecticut cattle has an important bearing. The first cow died on the eleventh day after leaving West Albany. These were standing in a pen adjacent to the first carload of cattle that went to Massachusetts on the same day. The development of the disease in the Connecticut cattle, which of course never were in the Brighton yards, serves to point to West Albany stock yards as the source of infection. However, as will be seen later, traffic in southern cattle seems to have been so loosely conducted that no yard through which such may have slipped is above suspicion when outbreaks occur in cattle which have passed through it.

In company with Dr. Kelly, I visited Watertown, Jefferson County, New York, and Little Falls, Herkimer County, whence these cattle were procured. We found at Watertown, that, according to Dr. J. R. Bell, United States government inspector at that port, not only had there been no disease of any description among the county farms, but that no cattle of any kind had been shipped into Watertown for any purpose whatever, or into the county, barring Canadian cows which are shipped *via* Cape Vincent en route to eastern points.

On this trip we investigated a rumored case in Oswego County at Vermillion, N. Y., — a case that had been reported to the New York Department of Agriculture. The cow was raised on the place, had never been off from it, nor had other cattle been brought to the place nor into the vicinity. The cow suffered from another disease.

At Little Falls we called upon Mr. William Cotter, of whom nine head of the first carload had been purchased. There had been no disease on his place or on the farms from which he purchased the cattle, nor had Buffalo or Chicago cattle been introduced.

Mr. A. L. Eaton, who lives about three miles from Little Falls, had sold six of the first carload; he is a buyer. He has a large pasture, where cattle from all parts mingle. He has not had, nor heard of, disease in cattle excepting those he sold to Mr. Smith. He had bought Buffalo cattle three months before; but according to Mr. Smith, at least part of these Buffalo cattle which he (Smith) bought died, showing their susceptibility to the disease. They did not infect the pasture, otherwise there would have been trouble before our visit. There were at the time of our visit sixty head of cattle in the pasture.

The disease could not have arisen either in Herkimer or Jefferson counties. There remains the possibility of car infection and yard infection at West Albany stock yards. I believe that infection of the Connecticut cattle at the unloading place in New Milford,

Conn., is practically excluded, for no western cattle are unloaded there, and cattle have since been unloaded there with no danger.

The possibility of car infection must be admitted until the use of each car through the entire season is proven. Since four different local cars were in use, perhaps five, infection must be pretty generally widespread, and car disinfection little practised, if due to this source. While it is my opinion that infection was not due to infected cars in any case, the possibility remains; a search of the uses to which those cars have been put will reveal whether this infection of either car has been possible. (Note: car numbers furnished by United States Bureau of Animal Industry shows no probability of car infection.)

The single cow that died in Albany was said to have been "all around the stock yards." Since she had not been in cars, her infection must have been at the stock yards, for there is no other possible source in Albany to which she had access. Quarantine cattle consigned to slaughter houses are said to be unloaded elsewhere.

A consideration of the facts regarding the treatment of the cattle at the West Albany stock yards, the time at which the disease appeared and the impossibility of their having contracted the disease earlier, forces the conclusion that they were infected at that point.

On August 1 the cattle of cars Nos. 10028, Rome & Watertown, and 22931, New York Central, were received from Herkimer and St. Lawrence counties, N. Y., and put into pens 15 and 16, alley D, respectively. They were forwarded, the first carload to Brighton, Mass., the second to New Milford, Conn., their only point of contact being when they were put into the contiguous pens. Cattle from car No. 10028 began dying in ten days thereafter, and the outbreak continued for ten days; cattle from car No. 22931 began dying in fourteen days, and continued about a week.

On August 8, cattle from car No. 10033, Rome & Watertown, were received from Jefferson County and put into pen 16 D. Some of these died between ten and fifteen days thereafter. On August 15, cattle from car No. 23015 were also received from Jefferson County and put into pen 17 D. Some of these died between twelve and fifteen days thereafter.

Of the eighty-five head in the four carloads put in pens 15, 16 and 17 at this time, forty-five died in from ten to twenty days thereafter, and the bulk of them died about fourteen days after infection.

The data pointing to the infection being in these pens accords

with the experimental evidence. The main difference seems to be that the disease is more virulent and has a quicker course when spread by natural means than artificial, — a condition which is borne out by a study of other outbreaks as well.

On July 25, Mr. Geo. Smith fed and watered a carload of cows *en route* from New York State to Brighton, Mass., at West Albany, in pen 16 D; Mr. A. W. Baggs also fed and watered a carload in pen 15 D, *en route* from New York State to Wilbraham, Mass. I further find, on consulting notes furnished by the management of the West Albany stock yards, that pen 16 D was used on July 11 and 18 by Mr. Smith. It is probable that pens 15 and 17 were also in use; indeed, the superintendent and others told me that it was the custom to open all the pens of alley D between market days, and permit cows to feed in them.

On August 15, a carload (No. 23033, New York Central) of cattle, consisting of twenty cows and three bulls, consigned to New Haven under the name of E. D. Williams, were entered into pen 16 D. Since no report of this stock has been made to Cattle Commissioner Sprague of Connecticut, and inasmuch as it was mixed stock, it is quite likely that the cattle were slaughtered in New Haven. This is the only reasonable explanation of disease not having broken out and being reported in this shipment.

If the cows that went into pens 15 and 16 D on August 1 were infected there, while other cows equally susceptible that went into these pens on July 25 were not, it is apparent that the infection became active at some period between these dates. On this supposition, we may be quite certain that the cattle ticks which were found on the cows in Massachusetts, Connecticut and Albany were hatched out, if in these pens, two or three days prior to August 1. Since these ticks do not hatch out under the most favorable conditions in less than three weeks, and under usual conditions in from five to six weeks, it is evident that the ticks from which they descended must have been dropped in these pens at from three to six weeks earlier. Three weeks prior to August 1 is July 10, and the latest date infection of pens 15 and 16 could have been expected in order to produce the disease which killed the cattle during the middle of August. Six weeks prior to August 1 is June 19, and is within a few days of the earliest date that infection probably occurred; for otherwise the cows put into these pens July 25 should have been infected from the earlier-hatched ticks.

It has been quite impossible to get a concise history of the infection of these yards, yet sufficient has been learned to incline the most sceptical to the belief that the difficulty lies in obtaining exact

proof of method of infection, rather than the fact that they were infected.

At least one possible source of infection has been discovered. On June 19, the books of the stock yard company show that a carload of seventy-eight calves, one dead (car No. 22989, New York Central), *en route* from Buffalo to New York, were stopped off and put into pen 15 D. The way-bill of the railroad company shows that a car No. 23033, with a similar consignment, was stopped off at the yards June 18. This way-bill was marked "quarantined cattle," showing them to have been cattle from the cattle-tick area. These calves were held in Albany until the 24th of June, awaiting a better market. According to the most reliable testimony Dr. Kelly and myself could get, some of these were at least yearlings, and were transferred certainly to pen 17 D. Our notes taken at the time of investigation show this. While I am of the opinion that the same testimony showed that these calves went into pens 15 and 16 D in turn, Dr. Kelly thinks not. However, the fact that the stock yards company received quarantine cattle into alley D, pens 14, 15 and 17, and harbored them about five days, is fully established.

NOTE.—Copy in part of letter from Dr. Kelly to Dr. Curtice:—

OCT. 25, 1897.

Dr. COOPER CURTICE, *Moravia, N. Y.*

DEAR SIR:—I sent you, on Friday evening, a Boophilus Bovis, which was taken by Mr. Rand, in my presence, from neck of a native horse, weighing about 1,400 pounds. This horse has been allowed to pasture in alley D and the yards adjoining, with the pony (from which the two-weeks-old ticks were taken), together with a number of colts. This accounts for the manner in which the ticks got on the pony. The pony referred to was purchased in Buffalo some time in August, and was shipped direct to West Albany, where it has been kept, and is still here. A portion of the time it has been kept in the barn, allowed to pasture in alley D and yards adjoining, and the balance of the time in the barn where it is at present. I am now satisfied that this pony picked up these ticks in alley D. I intend to look on the colts which pastured there at the time the horse and pony did, and will see if I cannot find more ticks. I do not know as *it has ever been proved* before that ticks would develop upon a horse, but certainly here is a case where they have.

In reference to yards 15 and 16, since we have found that the other carload of calves (No. 22989) were quarantined cattle, explains how these yards were infected. Since receiving the list from Washington, the railroad company corroborates it, and the cars Nos. 23033 and 22989 are correct. No. 22989 contained ninety-six live and two dead calves, as stated before. Both of these cars were unloaded, and the calves were

fed and kept at West Albany, in alley D and yards adjoining (15, 16 and 17).

I think we have now clear proof of how the yards in alley D, 14 to 17, inclusive, were infected. It should certainly be a lesson that in the future more care should be taken in the way that quarantined cattle are handled.

(Signed) WM. HENRY KELLY.

On June 19 there is record of a consignment of eight carloads of Chicago cattle to W. H. Munroe, Brighton, Mass., *via* West Albany. The cars used were Boston Live Stock Express Nos. 53, 89, 81, 51, 67, 21, 39 and 45. The first four were shipped east, according to the Boston & Albany Railroad books, on June 20; the second four, on June 21. The latter four cars at least were unloaded at the West Albany yards. Cattle from this lot were put into pens 3 and 4, alley E, and 15 and 16, alley D.

On June 23 a consignment of thirty-six steers was received at West Albany stock yards, *en route* for Brighton, Mass., W. H. Munroe consignee. These came in cars Boston Live Stock Express Nos. 19 and 64. On the 26th, eighteen head, the rest having been sold in Albany, were reshipped in car Boston Live Stock Express No. 58. These were said to have been put into shed No. 26. The above is from stock yard notes.

The railroad notes give four cars of steers, Boston Live Stock Express Nos. 73, 70, 19 and 64, showing some confusion between the two. These shipments to Munroe were not recorded as quarantine cattle, but comprise, with the Harrington shipment of calves (?), the only lots that Dr. Kelly and myself could find record of up to the present time, October 10, which could possibly have infected the suspected yards.

On June 17, W. H. Munroe, Brighton, Mass., consigned in Burton's stock car No. 55 a carload of quarantine cattle from Chicago to Boston. These were said to have been sold in Buffalo, and not to have reached Boston. The coincidence of the dates of shipment of the eight carloads and this carload suggest the possibility of mixing at Buffalo of the two lots, and the subsequent contamination of pens 15 and 16 by the quarantine cattle. Thorough investigation alone will determine the fact.

The thorough investigation of what has happened to each carload of quarantined cattle that has been shipped through Albany under the supervision of the United States Bureau of Animal Industry has been delayed even to the present time, October 11, on account of the delayed answer from the Bureau in reply to the request of Assistant Commissioner Flanders for the data relating

to such shipments. Dr. Kelly will make the investigation for New York State when the advices are received, and furnish you with a report thereon.

There is no unloading chute or quarantine pen now at West Albany; whatever quarantine cattle are unloaded there must be unloaded into the common stock-yard pens, and either driven directly for slaughter or taken into the pens used by other cattle. There is a tradition commonly entertained by the older stockmen that there was once a separate chute and pens for such cattle, but that these became old and decayed, and were finally pulled down as being of no more use.

The destruction of cattle by a contagious disease contracted in the progress of conveyance from one State to another naturally arouses the question of responsibility in the minds of the losers of those cattle.

The question which confronts your Board is, How may future outbreaks be prevented? This question is one which interests every northern State which is likely to receive southern cattle in the summer time. While the question of legal responsibility may never be taken up or pushed to a conclusion, that of responsibility for taking necessary steps to prevent future outbreaks may readily be arrived at.

The heavy losses in cattle due to Texas fever prior to 1889, and the attitude assumed by States in quarantining against the admission of southern cattle within their boundaries or their passage *en route* to other States, and the accompanying interruption of cattle traffic, led to the quarantine by the United States Department of Agriculture of all cattle south of a stated line, and their assuming oversight of all cattle transported from that area for immediate slaughter until they had been delivered into pens set apart for them at their destination. The line was established on the clinical evidence obtained by earlier investigation, and has been subject to subsequent revisions. The quarantine was found to be of such commercial utility that it has since been annually proclaimed.

The proclamation for the current year is: —

Regulations concerning Cattle Transportation.

U. S. DEPARTMENT OF AGRICULTURE, OFFICE OF THE SECRETARY,
WASHINGTON, D. C., Jan. 27, 1897.

To the Managers and Agents of Railroads and Transportation Companies of the United States, Stockmen and Others.

In accordance with section 7 of the act of Congress, approved May 29, 1884, entitled "An act for the establishment of a Bureau of Animal

Industry, to prevent the exportation of diseased cattle, and to provide means for the suppression and extirpation of pleuro-pneumonia and other contagious diseases among domestic animals," and of the act of Congress which became a law April 24, 1896, making appropriation for the Department of Agriculture for the fiscal year ending June 30, 1897, you are hereby notified that a contagious and infectious disease, known as splenetic or southern fever, exists among cattle in the following-described area: —

All that country lying south, or below, a line beginning at the north-west corner of the State of California; thence east, south and south-easterly along the boundary line of said State of California to the south-eastern corner of said State; thence southerly along the western boundary line of Arizona to the south-west corner of Arizona; thence along the southern boundary lines of Arizona and New Mexico to the south-eastern corner of New Mexico; thence northerly along the eastern boundary of New Mexico to the southern line of the State of Colorado; thence along the southern boundary lines of Colorado and Kansas to the south-western corner of Kansas; thence southerly along the western boundary line of Missouri to the south-western corner of Missouri; thence easterly along the southern boundary line of Missouri to the Mississippi River; thence northerly along the Mississippi River to the northern boundary line of Tennessee at the north-west corner of Lake County; thence easterly along said northern boundary line to the north-east corner of Henry County; thence in a northerly direction along the boundary of the Tennessee River to the north-west corner of Stewart County; thence in an easterly direction along the northern boundary of Tennessee to the south-western corner of Virginia; thence north-easterly along the western boundary line of Virginia to the northernmost point of Virginia; thence southerly along said boundary line to the north-east corner of Virginia, where it joins the south-eastern corner of Maryland at the Atlantic Ocean.

Whenever any State or Territory located above or below said quarantine line, as above designated, shall duly establish a different quarantine line, and obtain the necessary legislation to enforce said last-mentioned line strictly and completely within the boundaries of said State or Territory, and said last above-mentioned line and the measures taken to enforce it are satisfactory to the Secretary of Agriculture, he may, by a special order, temporarily adopt said State or Territorial line.

Said adoption will apply only to that portion of said line specified, and may cease at any time the Secretary may deem it best for the interest involved, and in no instance shall said modification exist longer than the period specified in said special order; and at the expiration of such time said quarantine line shall revert without further order to the line first above described.

Whenever any State or Territory shall establish a quarantine line for above purposes, differently located from the above-described line, and shall obtain by legislation the necessary laws to enforce same completely and strictly, and shall desire a modification of the Federal quarantine line to agree with such State or Territorial line, the proper authorities

of such State or Territory shall forward to the Secretary of Agriculture a true map or description of such line and a copy of the laws for enforcement of same, duly authenticated and certified.

Such States or Territories as now have a line established as last above mentioned can immediately forward certified copies of said line and laws for the enforcement thereof; and, if satisfactory to the Secretary of Agriculture, the same may be adopted at once, and the Federal line so modified.

From the fifteenth day of February to the fifteenth day of November, inclusive, during each year, no cattle are to be transported from said area south or below said Federal quarantine line above described to any portion of the United States above, north, east or west of the above-described line, except by rail for immediate slaughter, and when so transported the following regulations must be observed: —

1. When any cattle in course of transportation from said area are unloaded above, north, east or west of this line, to be fed or watered, the places where said cattle are to be fed or watered shall be set apart, and no other cattle shall be admitted thereto.

2. On unloading said cattle at their points of destination, pens, sufficiently isolated, shall be set apart to receive them, and no other cattle shall be admitted to said pens; and the regulations relating to the movement of cattle from said area, prescribed by the cattle sanitary officers of the State where unloaded, shall be carefully observed. The cars that have carried said stock shall be cleansed and disinfected as soon as possible after unloading and before they are again used to transport, store or shelter animals or merchandise.

3. All cars carrying cattle from said area shall bear placards stating that said cars contain southern cattle, and each of the way-bills of said shipments shall have a note upon its face with a similar statement. Whenever any cattle have come from said area and shall be reshipped from any point at which they have been unloaded to other points of destination, the cars carrying said animals shall bear similar placards with like statements, and the way-bills be so stamped. At whatever point these cattle are unloaded, they must be placed in separate pens, to which no other cattle shall be admitted.

4. The cars and boats used to transport such animals, the chutes, alleyways and pens used during transportation, and at points of destination, shall be disinfected in the following manner: —

(*a*) Remove all litter and manure. This litter and manure may be disinfected by mixing it with lime or saturating it with a five per cent. solution of carbolic acid; or, if not disinfected, it may be stored where no cattle can come into contact with it until after November 15.

(*b*) Wash the cars and the feeding and watering troughs with water until clean.

(*c*) Saturate the walls and floors of the cars, and fencing, troughs and chutes of the pens with a solution made by dissolving four ounces of chloride of lime to each gallon of water; or disinfect the cars with a jet of steam under a pressure of not less than fifty pounds to the square inch.

Cattle from the Republic of Mexico may be admitted into the United States to remain below said Federal quarantine line after inspection, according to law; but said cattle shall not be permitted to cross said quarantine line otherwise than by rail for immediate slaughter, except by special permit from the inspectors of the Bureau of Animal Industry, issued according to the regulations of the said Bureau; and no permit shall be issued except for cattle free from splenetic, or Texas, fever, or from contact therewith during the three months preceding the issuance of said permit, and which have been grazed in a locality free from infection of such fever.

Notice is hereby given that cattle infested with the *Boöphilus bovis*, or southern cattle tick, disseminate the contagion of splenetic, or southern, fever (Texas fever); therefore cattle originating outside of the district described by this order or amendments thereof, and which are infested with the *Boöphilus bovis* ticks, shall be considered as infectious cattle, and shall be subject to the rules and regulations governing the movement of southern cattle.

Stock yards companies receiving such cattle shall place the same in the pens set aside for the use of southern cattle, and transportation companies are required to clean and disinfect all cars and vessels which have contained the same, according to the requirements of this department.

The losses which formerly occurred to the owners of susceptible cattle, both in the interstate and export trade, by the contraction of this disease from exposure in unclean and infected cars and pens, and by means of the manure carried in unclean cars from place to place, became a matter of grave and serious concern to the cattle industry of the United States, until this danger was removed by the inspection of this department. It is absolutely essential, therefore, that this cattle industry should continue to be protected as far as possible by separating the dangerous cattle and by the adoption of efficient methods of disinfection.

Inspectors are instructed to see that disinfection is properly done, and it is expected that transportation and stock yards companies will promptly put into operation the above methods.

All prior orders conflicting herewith are hereby revoked.

J. STERLING MORTON,
Secretary.

The restriction placed upon traffic in cattle for feeding purposes and the comparatively complete separation of infected cattle from the others in the large stock yards of this country, cut down losses from this source to a minimum, yet outbreaks resulting in a total of thousands of dollars' loss have since annually occurred, due to evasions of the law along the quarantine line and in unprotected places.

In the present instance the loss was brought about *by the unloading of quarantine cattle into pens used by other cattle and by admitting other cattle thereto*, in direct violation of Regulation No. 2.

This, perhaps, was unintentional by the owner of the cattle, who merely wished to profit by an expected rise in the New York market; but the breaking of the regulations exists. It certainly was overlooked by the railroad men and ignored by the stock yard men.

I find that most carloads of cattle are shipped through from Buffalo to Boston, or New York. This run requires more than twenty-eight hours; it being claimed that cattle are often twenty-two hours in reaching Albany. It is rumored about the stock yards there that little attention is paid to the fact whether cattle are twenty-eight hours *en route* or forty-eight, further than it is for the profit of the stockman to care for his cattle.

Sections of the Revised Statutes referring to the Transportation of Animals.

SECT. 4386. No railroad company within the United States whose road forms any part of a line of road over which cattle, sheep, swine or other animals are conveyed from one State to another, or the owners or masters of steam, sailing, or other vessels carrying or transporting cattle, sheep, swine, or other animals from one State to another, shall confine the same in cars, boats, or vessels of any description *for a longer period than twenty-eight consecutive hours*, without unloading the same for rest, water and feeding, for a *period of at least five consecutive hours*, unless prevented from unloading by storm or other accidental causes. In estimating such confinement the time during which the animals have been confined without such rest on connecting roads from which they are received shall be included, it being the intent of this section to prohibit their continuous confinement beyond the period of twenty-eight hours, except upon contingencies hereinbefore stated.

SECT. 4387. Animals so unloaded shall be properly fed and watered during such rest by the owner or person having the custody thereof, or in case of his default in so doing, then by the railroad company or owners or masters of boats or vessels transporting the same, at the expense of the owner or person in custody thereof; and such company, owners, or masters shall in such case have a lien upon such animals for food, care, and custody furnished, and shall not be liable for any detention of such animals.

SECT. 4388. Any company, owner, or custodian of such animals who knowingly and willingly fails to comply with the provisions of the two preceding sections, shall, for every such failure, be liable for and forfeit and pay a penalty of not less than one hundred nor more than five hundred dollars. But when animals are carried in cars, boats, or other vessels in which they can and do have proper food, water, space, and opportunity to rest, the provisions in regard to their being unloaded shall not apply.

SECT. 4389. The penalty created by the preceding section shall be recovered by civil action in the name of the United States, in the circuit or district court of the United States, holden within the district where the violation may have been committed, or the person or corporation

resides or carries on its business; and it shall be the duty of all United States marshals, their deputies and subordinates, to prosecute all violations which come to their notice or knowledge

If the humane federal law requiring cattle to be unloaded at the end of each twenty-eight hours' confinement for feeding and watering is to be carried out, then many quarantine cattle must be unloaded at Albany. In this connection the shipment of quarantine cattle for slaughter to Albany and other points in New York and Massachusetts, where no federal office is located, must be considered. These cattle, of which in different years there are varying numbers, are delivered at any station and then driven to slaughter houses without supervision. Many cars are taken to other points, to be used without, so far as can be learned, any attempt or pretence at disinfection. These conditions continually expose the native cattle of these States, and, I may add, of other States, to attacks of Texas fever. The responsibility for the spread of disease by carloads of quarantine cattle which go to places where there are no pens set apart to receive them, and no provisions to adequately disinfect cars according to the regulations, or for attending to the enforcement of these regulations, lies with the officers of the Bureau of Animal Industry, who are charged with the enforcement of the law. The States are not responsible for the spread of disease until the cattle leave those places set apart for them to go to slaughter.

The Bureau authorities are aware that, when cattle are released from Chicago or Buffalo, consigned to Brighton or New York, or to a place in Massachusetts where there is no quarantine yard, these cattle may be unloaded at Albany, and that most of them in accordance with the twenty-eight-hour unloading law must be unloaded there, or they will be unloaded at some other place where there are no quarantine regulations or pretence at any. They have hitherto read their instructions as concerning the larger stock yards for the protection of the foreign and domestic cattle trade, and trusted to the exclusion of quarantine cattle for pasturage purposes to prevent disease in our own country. They have regarded their duties as ended when cattle were properly entered and released from the yards where their agents are stationed. They have overlooked the fact that cattle have been released to points where conclusive evidence was easily obtainable that their laws were not, and could not be, complied with as regards the released shipments. They have apparently made no effort to ascertain the fact whether quarantine cattle were being handled properly at such an important point as Albany, where quarantine

cattle are received *en route* and for immediate slaughter, and native cattle received and distributed to adjoining States. They have made no effort, that can be ascertained, to enforce the disinfection of cattle cars used in carrying quarantine cattle when these are unloaded at points where there are no officers.

The oversight of quarantine cattle until they are put into pens set apart to receive them cannot be relaxed on account of State laws permitting otherwise; for interstate relations are such that, as in the present case, an outbreak may occur in other States, due to relaxed precautions.

Suppose, in the present case, quarantine cattle had been unloaded into either or each of the cattle pens at Watertown, Norwood and Herkimer, N. Y., the native cattle would have been exposed in these places in New York State, and have died in Massachusetts and Connecticut. It cannot be said of any cattle pens in the United States that they will not be used for cattle in interstate traffic. They are built for cattle traffic, and cattle are shipped to and fro with no thought of State lines.

The duties of the federal authorities should be terminated only after they have delivered the cattle into pens set apart *en route*, or at their destination, and they have overseen the disinfection of the cars. If they cannot attend to this, they should refuse to release quarantine cattle destined to unprotected points. Having fulfilled their obligations in the delivery of quarantine cattle, they should then notify the State authorities that such are delivered, and turn their care over to them. Then they will have freed themselves from the responsibility of having delivered disease-breeding, proscribed cattle into an unsuspecting community; and the State may make suitable regulations for their handling, should they desire to receive them.

The conditions followed at present would be paralleled if United States authorities should convey with all possible care a carload of yellow-fever patients to some more or less important communities in our States, and quietly infect places where other people would contract the disease. The practice is indefensible and inexcusable. The wording of the United States agricultural regulations, quoted above, shows that they think it is.

There are other unavoidable conditions in railroad traffic that have heretofore spread Texas fever, and may again. Accidents delay cattle trains; sometimes cattle cars become broken *en route*, and the cattle either released violently or compulsorily. When such happens, places where this occurs should be quarantined by the State after notification by federal officers.

Another condition prevailing in other States through which the

quarantine line is drawn has a remote bearing upon the cattle traffic in Massachusetts. Prior to 1896 the shipment of cattle from infected areas in Virginia to any point outside was comparatively easy, both by cars and by driving the cattle across the line on foot, and then shipping them, — each of which was against the law. Since then, however, a more stringent State law, better enforced, has quite stopped such shipments. During the present year, however, quarantine restrictions put in force by the State of Illinois against Tennessee and Arkansas on account of disease transported from those localities show the incomplete enforcement of the quarantine line in those States. This condition of affairs along the line will more or less menace the cattle industry until the States enter into hearty co-operation in enforcing State and federal laws. At any time under such conditions the State of Massachusetts might be invaded, but on account of the nature of traffic at rare intervals. The possibility of infection from such source of some of the eight carloads of cattle bought at Chicago by W. H. Munroe, and stopped *en route* to Brighton at West Albany, is suggested.

In thus laying the responsibility for the spread of Texas fever at the door of the Bureau of Animal Industry, I do not intend in any way to exonerate railroad officials, stock yard companies or cattle men who knowingly or unwittingly override the law, but to draw attention to the first source, where the law may be more thoroughly carried out, and thus prevent infractions by others concerned. Those interested in cattle traffic in quarantined animals cannot be blamed too harshly for violations, when officials permit cattle to be released to points under conditions in which the law must be violated.

The laws of Massachusetts do not seem to have been violated in the recent outbreak by the introduction into the State of any disease-bearing cattle. The diseased cows introduced died. But one recovered animal was found to bear a single tick, and this at so late a date that the young could not possibly hatch out for infection of other cattle.

An examination of the method of handling cattle at the Brighton yards, the unloading of all quarantine cattle at the Brighton abattoir and the complete absence of data showing infection of these yards indicate that no infection has been in these yards this year. The quarantine imposed by the United States authorities may have been justified so long as suspicion attached to these yards in the course of investigation, but no longer. Unless it can be shown that the United States authorities had reason to suspect that infected cattle had passed through these yards in June, or the

first week in July, the quarantine was unjust, for the history of the outbreak pointed to an infection of the cattle before they passed through these yards. The only protection the State of Massachusetts has against future recurrence of losses from this disease is the insistence upon federal authorities carrying out the regulations of the United States Department of Agriculture in other States and in Massachusetts, or on the entire exclusion of such cattle from Massachusetts. The traffic for the present year is so inconsiderable that it may well be stopped, in view of the loss to the State that it might produce.

The laws of Massachusetts bearing on this point are as follows: —

SECT. 53. When animals are transported within this state from localities beyond its boundary lines, which localities the board of cattle commissioners deem to be infected, such animals may be seized and quarantined by the commissioners at the expense of the owners or consignees thereof, so long as the public safety may require; and if, in their judgment, it is necessary to secure that safety, they may cause such animals to be killed without appraisal or payment for the same.

SECT. 54. No Texan, Mexican, Cherokee, Indian or other cattle, which the cattle commissioners decide may spread contagious disease, shall be driven on the streets of any city, town or village, or on any road in this Commonwealth, nor shall they be driven outside the stock yards connected with any railway in this Commonwealth contrary to any order of the board of cattle commissioners.

SECT. 55. In all stock yards within this Commonwealth said Texan, Mexican, Cherokee, Indian or other cattle, which the cattle commissioners decide may spread contagious disease, shall be kept in different pens from those in which other cattle are kept

SECT. 56. Any person or persons violating any of the provisions of the two preceding sections shall be punished by a fine of not less than twenty nor more than one hundred dollars.

SECT. 37. Contagious diseases under the provisions of this act shall include glanders, farcy, contagious pleuro-pneumonia, tuberculosis, Texas fever, foot-and-mouth disease, rinderpest, hog cholera and rabies.

In the recent outbreak the action of the Cattle Commissioners of Massachusetts and Connecticut in cautioning buyers from bringing their cattle through the West Albany stock yards, or from New York, until the source of disease was located, was all the protection these States had. Though necessarily tardily taken, it probably prevented some loss. The fact that but few cattle passed through the infected yards prevented more loss. The final quarantine of the suspected pens by the New York authorities did not occur until the 5th of October, for the reason that they did not

wish to take action until the fact was proven that the cows did become infected in the suspected pens. In yards transacting any considerable business such delay would be productive of great loss.

The federal authorities have depended upon the New York State officials for an investigation and action, and have not investigated the outbreak outside of the Brighton yards. The tardy action of States in investigating such outbreaks should not be awaited for by the federal officers when interstate traffic is involved, and federal laws, over which they alone have supervision, have been violated. Had it not been for the investigation ordered by your own State, the source of infection would not have been definitely decided; each State involved would have believed the other at fault, and no relief against future outbreaks been proposed.

Résumé.

1. The outbreak of disease which destroyed at least thirty-five head out of fifty-eight cows transported from New York State to eastern Massachusetts was due to Texas fever, contracted in the stock yards at West Albany, New York.

2. The infection of the West Albany stock yards was due to the illegal unloading and detention of quarantine cattle in those yards, and presumably to a carload (or two) of quarantined young stock shipped from Chicago to New York, and detained about five days in said yards.

3. Future outbreaks may be prevented by the complete enforcement of United States laws by officers of the United States Bureau of Animal Industry, and the notification of the State Cattle Commissioners concerning the unloading of quarantine cattle into pens set apart for them by those officers.

4. The present State law relating to the unloading of cattle which may spread Texas fever seems adequate for all purposes, and, if carried out, will prevent Texas fever spreading from cattle delivered into "places set apart."

5. The investigation undertaken by the Cattle Commissioners will have been justified when adequate steps are taken to prevent future outbreaks; then Texas fever, as a disease of northern cattle, will become an historical reminiscence.

COOPER CURTICE.

The existence of Texas fever in Massachusetts this summer was first called to the attention of the Board of Cattle Commissioners by Commissioner Dennen, who had three cows, bought in Brighton, — two from the carload arriving

August 2, one from the carload arriving August 9, — which sickened and died.

Specimens from the spleens and kidneys of two of these cows were examined by Dr. Langdon Frothingham, and the organism of Texas fever found to be present; the diagnosis was confirmed by Dr. Theobold Smith.

As soon as it became clear to the Cattle Commission that it had an outbreak of Texas fever to deal with, the following notice was sent to the principal shippers of cattle from New York State into Massachusetts: —

COMMONWEALTH OF MASSACHUSETTS.

BOARD OF CATTLE COMMISSIONERS,
COMMONWEALTH BUILDING, BOSTON, Aug. 27, 1897.

DEAR SIR: — It having come to the notice of the Massachusetts Cattle Commission that cows brought from certain localities in New York State, and sold at Union Market, Watertown, and the stock yards, Brighton, have in some instances died of Texas cattle fever after being taken away by purchasers, we would notify you of the above facts, and warn you against bringing in any cattle from New York State until the 1st of October, except beef cattle to be killed at the slaughter houses.

Yours truly, AUSTIN PETERS,
Chairman.

The leading agricultural papers were also requested to make the matter public, which they did at once, and intending purchasers were informed that there was a risk in buying New York State cows. The result was that the importation of cattle from New York State into Massachusetts was practically stopped for the time being, and it became pretty certain that the trouble was traceable to the stock yards at West Albany; such cattle as were shipped into Massachusetts from New York State were sent around a northern route by way of the Vermont Central Railroad, until the weather became so cold that there was no more danger to cattle coming through the West Albany stock yards.

Owing to these precautions, the loss of animals was confined to the three carloads mentioned in Dr. Curtice's report.

From Dr. Cooper Curtice's report it may be seen that the point where the New York State cows became infected was

at West Albany, and before it was even decided to employ him to investigate the outbreak it is clear that the Massachusetts Cattle Commissioners were right in being of the opinion that the disease was not contracted in this State; however, upon learning that there was an outbreak of Texas fever in Massachusetts, the chief of the Bureau of Animal Industry at Washington telegraphed to Dr. D. D. Lee at Boston, the veterinarian having charge of the Bureau's work at this port, under date of September 2, quarantining the Brighton yards against export cattle.

Later, when it became evident that the animals that afterward died had only been in pens 11 and 13 on Texas Street, and pens 33 and 35, known as J. S. Henry's pens, on Front Street, the quarantine was changed on September 23 to include only these four pens, until further notice. This quarantine upon the four pens has not been officially removed, but expired on November 15 by the time limit in the proclamation of the Secretary of Agriculture defining the infected area, extending from February 15 to November 15.

By advice of Dr. Curtice after he commenced his investigation of the outbreak, four cows were bought and kept in pens 11 and 13, to determine whether or not they were infected.

There was no necessity for experimenting with pens 33 and 35 on Front Street, as J. S. Henry sells cattle from other points that pass through these pens every week, and there is no record of any creatures dying of Texas fever this season that passed through his pens except from the three carloads that came from New York State through the West Albany stock yards last August.

The New York State cattle were first unloaded into pens 11 and 13, Texas Street, and in this respect were handled differently from any other cattle consigned to Mr. Henry; and as steers for slaughter also pass through pens 11 and 13, there was more reason for considering these pens a possible source of danger.

After buying these cows, two were kept in pen 11 and two in pen 13 from September 28 until October 15, when they were removed to a shed on the same street that had not

been used for cattle. Here they were kept for eighteen days, their temperature being taken daily, as follows: —

DATE.	No. 1. Red Cow, White on Udder.	No. 2. Red Cow, Balls on Horns.	No. 3. Black and White Cow, Middle of Tail White.	No. 4. Black and White Cow, Half of Tail White.
	Degrees.	Degrees.	Degrees.	Degrees.
October 15, . .	102	$102\frac{4}{5}$	$102\frac{1}{5}$	$102\frac{3}{5}$
16, . .	101	$101\frac{3}{5}$	$101\frac{2}{5}$	$101\frac{3}{5}$
17, . .	$101\frac{3}{5}$	$101\frac{4}{5}$	$101\frac{4}{5}$	102
18, . .	101	$100\frac{4}{5}$	101	102
19, . .	101	101	$101\frac{3}{5}$	$101\frac{3}{5}$
20, . .	101	$100\frac{3}{5}$	$101\frac{1}{5}$	101
21, . .	$100\frac{4}{5}$	$100\frac{2}{5}$	$101\frac{2}{5}$	101
22, . .	$100\frac{2}{5}$	$100\frac{2}{5}$	101	$100\frac{3}{5}$
23, . .	$100\frac{4}{5}$	$99\frac{4}{5}$	$100\frac{2}{5}$	$100\frac{2}{5}$
24, . .	101	$100\frac{1}{5}$	$100\frac{3}{5}$	$100\frac{4}{5}$
25, . .	$101\frac{2}{5}$	$101\frac{1}{5}$	101	$100\frac{3}{5}$
26, . .	$99\frac{4}{5}$	$100\frac{2}{5}$	$100\frac{3}{5}$	102
27, . .	$101\frac{3}{5}$	$100\frac{1}{5}$	101	$101\frac{1}{5}$
28, . .	$101\frac{4}{5}$	$100\frac{2}{5}$	$99\frac{4}{5}$	101
29, . .	101	$100\frac{2}{5}$	$101\frac{1}{5}$	$100\frac{2}{5}$
30, . .	$101\frac{2}{5}$	$100\frac{1}{5}$	100	101
31, . .	$101\frac{1}{5}$	101	$100\frac{2}{5}$	$101\frac{2}{5}$
November 1, . .	101	$101\frac{1}{5}$	101	$100\frac{4}{5}$

At the end of this time the cows were sold, having remained in apparently perfect health; and during the latter half of this period, when the temperatures were taken daily, it can be seen by the above table that these remained normal.

To be still further positive that there has been no infection from the Texas fever organism, Dr. Langdon Frothingham,

a few days before the animals were sold, made cover-glass preparations of their blood, and under date of November 4 reports that he was unable to find any of these organisms in their blood.

It is therefore clear that the source of infection was at the West Albany stock yards. These stock yards became infected because there is no provision for furnishing separate chutes and pens for quarantine cattle, as required by the rules and regulations of the Bureau of Animal Industry; and there is no agent of the Bureau of Animal Industry there to see that these rules and regulations are enforced.

Notwithstanding the fact that suspicion pointed much more strongly to the West Albany stock yards as the infected area, as will be seen from the information gathered by the Massachusetts Cattle Commission, yet for some reason the Bureau of Animal Industry chose to place the odium on the stock yards at Brighton, ignoring the West Albany stock yards, if a quotation from a letter of Dr. Cooper Curtice is correct. He writes, under date of December 8, as follows: —

The only step that the Bureau took regarding the outbreak was to quarantine the Brighton yards. Up to October 14, or since, for that matter, the Bureau took no measures to ascertain where the disease was disseminated in this State (New York State), other than to call it to the attention of the New York Commissioner of Agriculture, about the middle of September, and, I believe, ask him to investigate. No quarantine of those West Albany yards was attempted until after frosts began, — early in October; then the assistant New York commissioner sent Dr. Kelly out there, to tell them that, if they continued to admit cattle to alley D and its pens, he would quarantine the whole yards.

While not a legal procedure, it perhaps accomplished its purpose. The advice of your commission to Massachusetts buyers accomplished more.

The whole matter at West Albany was handled in a very unscientific and illegal manner by both the State and the Bureau. In the first place, the yard should have been quarantined by the Bureau at the same time as the Brighton yards. In the second place, the State authorities should have quarantined on suspicion. The commissioner of New York State was, however, partially excusable, if not wholly, from the fact that the Bureau had already thrown the fault upon the Brighton yards by their act of

quarantine without further action in regard to other places, as West Albany.

Moreover, the State law is poorly drawn up, and requires such publication to be made that the department is unwilling to take steps unless the fact of infection of a given place is established. This procedure may do in some kinds of work, but not in contagious diseases. The United States Bureau of Animal Industry may take steps to prevent recurrences after Feb. 15, 1898, when a new proclamation will go into effect. They may have felt that further quarantine after the middle of October (by which time the commissioner of the New York State Department of Agriculture had taken his steps) was unnecessary. For some reason I have yet to learn of any case prosecuted by the Bureau of Animal Industry against carriers for violation of the quarantine law.

While the losses to cattle owners in Massachusetts and Connecticut were not very heavy, yet in many instances they were incurred by farmers who could ill afford to bear them; beside which, the quarantine on the Brighton stock yards caused some loss and inconvenience to the Boston & Albany Railroad Company.

It is to be hoped that such an occurrence may not be permitted to take place another season, by requiring the West Albany Stock Yard Company to fit its pens to fulfil the requirements of the Bureau of Animal Industry, and by the Bureau having an agent stationed at this important point.

In fact, Dr. D. E. Salmon, chief of the United States Bureau of Animal Industry, writes, under date of November 2, to the Massachusetts Cattle Commission, in part as follows: —

I recognize the fact that Albany is an important point to guard, and have intended to have some one stationed there next season, if possible.

ACTINOMYCOSIS.

During the year a number of cases of actinomycosis, or lumpy jaw, have occurred among the cattle of the State. This disease is caused by a fungus belonging to the mould family. These fungi are called actinomyces because of their star-shaped appearance under the microscope, and the disease is known as actinomycosis. So far as is known, it does not seem to spread to any extent from one animal to another,

but the fungus is thought to be on the grain or straw, and it is from this source that the affected animal is generally thought to acquire it.

Most commonly the primary seat of the disease is in the jaw, starting in the alveolus of a tooth. The actinomyces frequently find lodgement in the cavities caused by the shedding of the temporary or milk teeth before the permanent teeth make their appearance. In time a large bunch may develop on the face or jaw, and it was because of the nature of the changes set up in the bone that the disease got its former name of Osteo Sarcoma.

After the breaking down of the enlargement, it is possible that an animal may swallow some of the discharge containing the little yellow granules or fungous growths, and in this way secondary infection may take place. The actinomyces may also be absorbed or find lodgement in other organs of the body. For example, it seems to be possible for the fungous growth to gain an entrance at the opening of the milk duct and find lodgement in the udder. Three cases of what appear to be infection in this way have come under the observation of one of the members of the Board.

The first occurred some years ago, in New Hampshire, under the following circumstances: a heifer was noticed to be suffering from the form of actinomycosis known as "lump-jaw;" this was discharging freely, and at this time she was kept in a box stall in the farm hospital; she was finally destroyed. Shortly afterwards a sow with her litter of pigs was placed in this box, and before her pigs were weaned an enlargement began to develop on the left hind portion of the udder. It gradually grew larger, and finally broke and discharged; and because of this, the pigs were weaned and she was destroyed. The post-mortem examination showed no trace of disease except in this portion of the udder, and microscopical examination showed a beautiful specimen of the ray fungus, or actinomyces. The disease in this case was only present in the udder, the fungus probably finding its entrance through the milk duct, the active condition of this organ aiding its development.

The second case occurred in a Lawrence cow; it was quarantined under suspicion of having tuberculosis of the

udder, which was hard and nodulated to the touch. The cow was tested and condemned, and on autopsy was shown to have tuberculosis of the lung and bronchial gland; cultures from this gland were later used by Prof. Theobold Smith in some experiments with tuberculosis. The udder proved to be infiltrated with small nodules with yellow centres, which proved later to be actinomycosis.

The third case occurred at Amesbury, and was very similar to the second, the cow being condemned on physical examination because of the condition of the udder. The cow was free from disease except in this organ, and on section it was found to be studded with small minute nodules with yellow centres, not so well marked, however, as in the second case.

In both these cases, on a superficial cursory examination, this condition might easily have been mistaken for tuberculosis; but on closer inspection it was noticed that the yellowish centres were imbedded in a well-marked band of fibroid tissue. In tuberculosis small-celled proliferation with a tendency to caseation is more marked; while in actinomycosis there is usually more of a tendency to circumscribed fibrous changes, with sometimes a honeycombed structure containing small yellowish granular masses, which may often be squeezed out by the thumb nail.

In all three of these cases the udder seemed to be the initial seat of the disease, the milk duct being the possible source of infection.

Actinomycosis is by no means a typical contagious disease, in that it is not usually conveyed from one animal to another; but an animal with actinomycosis of the udder is by no means a fit animal for dairy purposes, and neither should an animal with generalized actinomycosis be passed as fit for beef.

Glanders.

During the past year 485 horses have been reported to the Board of Cattle Commissioners as suspected of being affected with glanders, or farcy. At the time of compiling this report, December 20, 402 had been killed, 81 had been examined and released and 2 were still in quarantine and under observation.

The following list gives the cases reported from each city and town: —

Glanders reported in 1897.

Cases in: —		Cases in: —	
Amesbury,	1	Merrimac,	1
Andover,	1	Melrose,	7
Arlington,	2	Millbury,	5
Auburn,	2	Milford,	1
Belchertown,	1	Millis,	1
Bellingham,	1	Milton,	1
Boston,	144	Montague,	2
Brimfield,	1	Natick,	1
Brockton,	1	Needham,	1
Cambridge,	29	New Bedford,	3
Canton,	1	Newbury,	1
Charlemont,	1	Newton,	2
Chelmsford,	2	Paxton,	1
Chelsea,	1	Plymouth,	1
Chicopee,	3	Quincy,	11
Clinton,	1	Randolph,	2
Concord,	1	Raynham,	2
Conway,	1	Revere,	1
Danvers,	3	Rockland,	1
Dartmouth,	1	Royalston,	1
Dedham,	1	Somerville,	22
Dighton,	1	Southborough,	1
Easthampton,	1	Springfield,	5
Easton,	2	Stoneham,	2
Everett,	6	Sutton,	1
Fall River,	16	Taunton,	1
Fitchburg,	3	Upton,	2
Foxborough,	3	Walpole,	1
Framingham,	1	Waltham,	2
Grafton,	8	Ware,	1
Groveland,	1	Wayland,	1
Haverhill,	2	Wellesley,	1
Hingham,	4	Westborough,	3
Holyoke,	4	Westfield,	8
Hopedale,	1	West Newbury,	1
Hudson,	1	Weymouth,	1
Lanesborough,	1	Winchester,	2
Lawrence,	5	Winthrop,	1
Leicester,	1	Woburn,	10
Lynn,	19	Worcester,	84
Malden,	3		
Medfield,	4	Total,	485
Medford,	3		

These figures show an increase of cases reported as diseased or suspicious over 1896 of 101, or of actual cases killed of 61. In last year's report it was said that there was an increase in 1896 over the cases in 1895, and this was attributed in part or whole to a better understanding of the law requiring all persons to report suspected cases to local boards of health, and requiring these boards in turn to report to the Board of Cattle Commissioners. But without any better understanding of the law the number of animals reported this year is much greater than last, and by no means represents all the cases that occur, as many horses are killed by owners who do not wish to have it known that the disease exists in their stables, and therefore they do not report it to the local board of health; and in some instances doubtless local boards of health are remiss in reporting cases to the Board of Cattle Commissioners if a horse is killed with the consent of the owner.

There is no doubt concerning the increase of glanders, and this being the case, it must be considered by what means this malady extends itself.

Glanders and farcy are one and the same disease, and it has long been acknowledged that it spreads by means of a germ which may be conveyed from horse to horse by one animal coming in immediate contact with another, by the virus being conveyed from one horse to another by means of curry-combs, brushes, harness and the like, by a healthy horse occupying a stall used by a diseased one, and in similar ways. But to account for its marked and in some ways mysterious increase the past two or three years, there must be another factor besides horses rubbing noses on the street, infected stables, and unprincipled traders in old, worn-out horses; and this factor must be the public watering troughs in our cities and towns; this was the opinion of the Board, as given in its report of two years ago, again last year and reiterated this year.

The reported cases of glanders were, in 1894, 230; in 1895, 250; in 1896, 384; and in 1897, 485; that is, the cases reported have more than doubled in the past three years, and it is probable that some of this increase is due to the public watering troughs.

In substantiation of the fact that it is possible that glanders can be conveyed into the horse's system by means of drinking water containing the glanders bacilli, it is only necessary to refer to a brief report of some experiments carried on by Mon'r Edward Nocard of Alfort, France, as given in the "American Veterinary Review" for September, by Dr. A. Liautard. For these experiments twelve cavalry horses were furnished by the Secretary of War, and placed at M. Nocard's disposal at Alfort. They were first tested with mallein, to be sure that they were free from glanders, and none reacted. Nov. 30, 1896, all of these horses were given water from a pail, each one receiving a certain well-measured quantity of culture of the glanders bacilli. A few days after, varying from four to eight days, there was noticeable a great oscillation in the temperature, indicating a febrile condition. After the eighth day, in some of them enlarged lymphatic glands were noticed, which later assumed the character of the glands noticed in glandered horses. Dec. 15, 1896, they were all tested with mallein, and all reacted. Jan. 15, 1897, all were again tested, and all reacted, although not all to the same extent as at the first test. January 21, three showed so much evidence of disease that they were destroyed.

The others were kept for further experiment, Professor Nocard wishing to see if glanders could be cured by mallein. By May there were six horses that failed to react to mallein, and in July four of these were killed; and although lesions of glanders were found, yet when these lesions were inoculated into donkeys and guinea-pigs they failed to produce disease; in other words, these horses were cured by successive injections of mallein.

These experiments are interesting, because they show that slight, undeveloped cases of glanders can be cured by repeated injections of mallein; but this does not have much to do with the question of glanders as considered here, because the wisdom of attempting to treat cases of glanders as they are reported to this Board is very questionable, and the better course seems to be to have such animals destroyed, as is at present done.

The chief interest lies in the fact that twelve horses, or

one hundred per cent. of those experimented with, could contract glanders through the alimentary canal, when the bacilli were in the water; hence proving the possibility of contaminated drinking water being a potent source of danger, — a fact that has hitherto been disputed by many able authorities. Therefore, in a locality where glanders is prevalent, the public watering troughs should have the water shut off from them; or, if these misplaced charities will not be abandoned, horse owners should on no account allow their horses to drink from them, and should forbid their teamsters to water horses at them, as well. If horses have such long hours as to need water before returning home, the teamster should be made to carry a pail, and draw water from a faucet for his horses.

If a practical demonstration is wanted of the utility of abandoning public water troughs, the history of glanders at Worcester and its vicinity the last two years will serve as an illustration. During 1896 one hundred cases of glanders were reported from Worcester; in 1897 there seemed to be no prospect of a diminution; finally, in April, it increased to such an extent that seventeen cases were reported during the month. This led to a conference between the chairman of the Cattle Commission, Mr. Herrick, Mr. Coffey, agent of the Worcester Board of Health, and the water registrar of Worcester, with the result that it was decided to close the public water troughs from May 8 to July 1. In addition, Mr. Herrick has kept the auction rooms of that city under constant surveillance, having any glandered horse found at these places killed. The result has been a falling off in the number of cases to eighty-four for the year, a marked decrease being noticed soon after having the watering troughs closed, as may be seen by the following table. Many of the cases reported as Worcester animals were horses brought in from adjoining towns by unscrupulous persons, to be sold at the Worcester auction rooms: —

Cases of Glanders in Worcester, Dec. 20, 1896, to Dec. 20, 1897.

Date.	Condemned.	Released.	Date.	Condemned	Released.
December, 1896, after 20th.	1	1	August, . . .	2	1
January, 1897, . .	5	1	September, . .	6	1
February, . . .	8	1	October, . . .	4	3
March, . . .	4	1*	November, . .	3	1
April,. . . .	17	–	December, to 20th, .	2	–
May, ...	10	1	Total of each, .	73	11
June, ...	6	–	Total quarantined,	84	
July, ...	5	–			

* Released in May, killed in October.

Total for August, September and October, 12, or 20 per cent.

It can be seen that after watering troughs were closed there was a marked falling off, and that during the dry months there was less than in April and May.

In contrast to the above table, the cases occurring in Boston, Cambridge, Somerville and Quincy, four neighboring cities, where glanders has been especially prevalent the last year, will show how it increases when horses drink the most, and just afterward, when nothing has been done to stop its spread by closing the public watering troughs (Cambridge closed a trough at East Cambridge, September 1, for about two weeks).

Date.	Boston.		Cambridge.		Somerville.		Quincy.	
	Condemned.	Released.	Condemned.	Released.	Condemned.	Released.	Condemned.	Released.
December, 1896, after 20th.	2	–	2	–	–	–	–	–
January, 1897, . .	10	–	–	–	–	–	–	–
February, . . .	9	–	–	–	1	–	1	–

DATE.	Boston.		Cambridge.		Somerville.		Quincy.	
	Con-demned.	Released.	Con-demned.	Released.	Con-demned.	Released.	Con-demned.	Released.
March, ...	7	–	–	–	1	–	–	–
April,			3	–	2	2	–	–
May, . . .	18	1	–	–	–	–	–	–
June,			2	–	1	–	1	–
July, ...	19	–	–	–	1	–	1	–
August, . . .	14	–	10	–	7	3	2	–
September, . . .	21	–	3	2	1	–	3	–
October, . . .	18	–	3	–	2	1	2	1
November, . . .	14	–	2	–	–	–	–	–
December, to 20th, .	11	–	2	–	–	–	–	–
	143	1	27	2	16	6	10	1
Totals, . . .	144		29		22		11	

Grand total, ... 206
Total for August, September and October, 93, or 45 per cent.

It will be seen by the two tables that during August, September and October, at Worcester, only twenty per cent. of the cases of the year occurred; while in Boston, Cambridge, Somerville and Quincy, forty-five per cent. of the cases of the year occurred during these months.

If the increase in the amount of glanders be considered from the localities where it exists, it will be found that it is largely, in fact almost wholly, confined to twenty-eight cities and towns, with Boston as a centre, and the other towns covering a territory that is continuous between them and Boston; and that in many, if not all, there are express men, teamsters and others whose teams pass almost daily to Boston and return, and who water their horses at infected watering troughs on the way, or infect the troughs with glandered animals of their own.

The following table shows that, outside of Boston and twenty-seven adjoining cities and towns, only eighteen more cases of glanders were reported in 1897 than in 1896, while within this comparatively small area there were eighty-three more cases reported than in 1896.

	1896.	1897.		1896.	1897.
Boston,	128	144	Newton,	5	2
Cambridge,	13	29	Needham,	5	1
Somerville,	9	22	Dedham,	5	1
Everett,	2	6	Hyde Park,	2	–
Chelsea,	4	1	Milton,	–	1
Revere,	–	1	Quincy,	3	11
Malden,	6	3	Weymouth,	–	1
Saugus,	2	–	Randolph,	1	2
Lynn,	3	19	Rockland,	–	1
Melrose,	–	7	Hingham,	–	4
Stoneham,	3	2	Cohasset,	1	–
Woburn,	–	10	Scituate,	1	–
Winchester,	1	2			
Medford,	1	3	Total for Boston and 27 adjoining towns,	192	275
Arlington,	1	2			192
Watertown,	1	–	Increase of 1897 over 1896,		83

Total for whole State, 1896,	384
Less,	192
Number of cases outside Boston and 27 adjoining towns in 1896,	192
Total for whole State, 1897,	485
Less number in Boston and 27 adjoining towns,	275
Number of cases outside Boston and 27 adjoining towns in 1897,	210

In 1897,	210
In 1896,	192
Increase for year outside these cities and towns,	18

Per cent. of glanders in Boston and 27 adjoining towns to total in State, 1896,	50
Same in 1897,	56½+
Relative per cent. of increase of glanders in Boston and 27 adjoining cities and towns to total in State of 1897 over 1896,	6½+

During the spring of the present year the Board of Health of the city of Boston secured the passage of the following act: —

[CHAPTER 178, ACTS OF 1897.]

AN ACT RELATIVE TO ANIMALS AFFECTED WITH INFECTIOUS DISEASES.

Be it enacted, etc., as follows:

SECTION 1. Any owner, agent or other person in charge of or called to examine an animal in the city of Boston, affected with either of the diseases known as glanders, farcy or rabies, shall forthwith report to the board of health of said city the name of the owner and place of keeping of such animal.

SECT. 2. Said board, when satisfied upon examination that any animal within said city is affected by either of said diseases, shall cause such animal to be killed or otherwise disposed of.

SECT. 3. Any person violating any provision of this act shall for each offence be punished by a fine of not exceeding one hundred dollars, or by imprisonment in the house of correction not exceeding one year. [*Approved March 19, 1897.*

The Board of Health of the city of Boston employs a competent veterinarian, and has continued the same man in the position for several years, and it is not likely that political changes will interfere with the present incumbent; even if he were removed from his place, in the present state of education and public opinion, it is more than probable that it would be filled by another equally well-educated and qualified veterinarian; therefore, the act as passed cannot be objected to, provided that the cases that occur under his jurisdiction are promptly and fully reported to this Board as soon as the animals are killed.

At the same time, this act established a precedent that might be mischievous and pernicious in the extreme, if it were secured for other cities and towns, where the conditions that exist in Boston do not obtain and are not likely to become the same. It is therefore better that the control of contagious animal diseases be continued in the hands of a central body, having knowledge of the existing conditions of domestic animals in all parts of the State, and in a position to secure and direct co-operation between different localities when necessary.

There has never been any objection on the part of the commission to having glandered horses killed by the local board of health or by the inspector of animals, if the owner was satisfied that the horse was glandered; if he is not satisfied, he should be allowed to resort to the Cattle Commission, as a court of last appeal. In any event, local boards of health should comply strictly with the law requiring all cases to be reported at once and in full to the Board of Cattle Commissioners; and a clause in the law, giving a board of health power to order horses infected with glanders and farcy to be killed, should not exempt it from this obligation.

The Board has been as prompt as possible during the year in dealing with cases of glanders, but in some instances doubtful cases have to be quarantined for some little time before a correct conclusion can be reached. In doubtful cases the most satisfactory method for arriving at a diagnosis has been the test of inoculating guinea-pigs. For a more complete account of this work, the reader is referred to Dr. Frothingham's report. (See page 558.) Mallein has been little used by this Board, and needs further use before it can be decided to just what extent it is valuable.

Rabies.

During 1897, cases of rabies, or suspected cases of rabies, continued to be reported; nineteen of these were dogs. In addition, there was an outbreak in a herd of cattle at South Hadley, in August, resulting in the loss of seven or eight cows, and possibly others in the neighborhood.

Eleven of the rabid dogs were reported during the first

three months of the year; since then, fewer cases have been heard of. It is, therefore, to be hoped that those reported early in the season were among the last of the outbreak mentioned in our annual report of 1897 as beginning in December, 1895; that it has now commenced to rapidly diminish in frequency; and that there will soon be no more occurrences of this malady in Massachusetts for several years, — when, if history repeats itself, as it does, as a rule, there will again be two or three years when this troublesome disorder will reappear.

Late in January, two cases were reported from Waltham, one of which, it was afterward ascertained, had run from Salem and was later found dead in Auburndale. The other dog's origin was unknown; but, as both seemed to have been dangerous, the following letter was sent to the boards of health of the towns through which the Salem dog may have run between that city and Auburndale, where he was found dead: —

COMMONWEALTH OF MASSACHUSETTS.

BOARD OF CATTLE COMMISSIONERS,
COMMONWEALTH BUILDING, BOSTON, Feb. 17, 1897.

To the Board of Health.

GENTLEMEN: — A dog belonging to Mr. E. S. Little of Salem bit Mrs. Little January 26, and then ran away, appearing in Waltham January 27, showing symptoms of rabies and biting several people, and probably dogs also. A few days later his body was found in Auburndale, evidently having died a few days before. Rabbits inoculated from him died of septicæmia, as he was slightly decomposed, but he was undoubtedly rabid. His course was undoubtedly a pretty direct line between Salem and Waltham, and he may have done some damage on his route.

Another dog known to have been rabid, whose origin is unknown, was killed in Waltham about January 20, after having bitten a man.

As there seems to be some danger from rabies as the result of these two cases, we consider it our duty to report the matter to you, in order that you may notify the police of your town to report to you any dogs that may be suspicious, and, if the circumstances seem to warrant it, to order dogs in your town muzzled.

Yours respectfully, AUSTIN PETERS,
Chairman.

This letter was sent to Salem, Swampscott, Lynn, Saugus, Malden, Medford, Lexington, Belmont, Watertown, Peabody, Lynnfield, Wakefield, Melrose, Stoneham, Winchester, Arlington, Cambridge, Waltham and Newton.

As a number of cases of rabies were reported to Dr. O'Connell, at Holyoke, late in January and in February, the following letter was sent to the boards of health of Holyoke and adjoining towns: —

COMMONWEALTH OF MASSACHUSETTS.

BOARD OF CATTLE COMMISSIONERS,
COMMONWEALTH BUILDING, BOSTON, Feb. 27, 1897.

Chairman Board of Health.

DEAR SIR: — Dr. Maurice O'Connell of this Board reports an outbreak of rabies among the dogs of Holyoke. We suggest, if the circumstances seem to warrant it, that the boards of health of Holyoke and adjoining towns order dogs to be muzzled, if running at large, or kept under restraint by their owners for ninety days from this date.

The police of these towns should have orders to report dogs acting strangely to the boards of health, such dogs to be secured in a safe place and a notification at once sent to Dr. O'Connell, who will investigate the matter, and, if possible, send the bodies of dogs dying under suspicious circumstances to the laboratory of the Cattle Commission, in order to ascertain definitely whether the dog was rabid, or not.

Yours respectfully, AUSTIN PETERS,
Chairman, for the Board of Cattle Commissioners.

The above letter was sent to Holyoke, West Springfield, Springfield, Chicopee, Westfield, Southampton, Easthampton and South Hadley.

Two cases of canine rabies were reported from Lynn, one in May the other in July. After the one in July, the Lynn board of aldermen, at a meeting July 20, upon the recommendation of the Board of Health and Inspector of Animals, passed an order that all dogs in Lynn should be muzzled until October 1.

On Aug. 25, 1897, Dr. O'Connell received a very urgent call from Mr. Myron Judd, chairman of the local board of health for the town of South Hadley, requesting him to go at once to the farm of Brown & Avery. The farm is located

in that part of the town known as Pearl City, a large portion of which is situated directly at the foot of Mt. Holyoke. In this section of the mountain it is rather woody and quite a place for hunting dogs, as fox hunters go there a great deal. He immediately went there, and found a cow, six years old, a good-looking animal. Her condition was very bad, eyes bulging, muscles twitching, striking the ground with her front feet, moaning and bellowing, frothing at the mouth, arched back, and presenting symptoms of rabies. The animal was immediately ordered quarantined.

On August 28 he was again summoned to the same farm, and found another cow presenting similar symptoms to the first. The first cow seen was found dead at this visit. The skull of No. 1 was opened, the brain removed and sent to Dr. Langdon Frothingham at the Harvard Medical College. Dr. O'Connell, having been appointed by the governor a delegate to the meeting of the United States Veterinary Medical Association, to be held in Nashville, September 7 to 10, left Holyoke on September 3, Friday evening. Before going he placed the matter in the hands of Dr. John Roberts of Northampton, a graduate of McGill University, Montreal, with instructions to keep a close watch of all the animals, and, if any of them showed symptoms of the disease, to immediately quarantine them. Upon Dr. O'Connell's arrival home from Nashville, on the 12th of September, he proceeded at once to the affected farm, and learned that four more head had died, and also that the one that was taken on the 28th was dead. Dr. Roberts reported that five of them died during Dr. O'Connell's absence, all presenting the same symptoms as the first cow.

On September 13 one more was taken sick. This cow died on the 18th, showing precisely the same actions and symptoms as the other six, making in all seven cows which there is good reason to believe had rabies. The man in charge of the farm states that he lost two more cows about two weeks previous to the first visit on August 25. He also says that the two animals acted precisely like the ones that died after the first visit. On September 23, Dr. Frothingham reported that he had made inoculations on rabbits from the brain of the diseased cow sent him, and that the rabbits

came down with the disease, showing unmistakable signs of rabies, therefore confirming the original diagnosis.

On November 23, Dr. O'Connell was called to see another cow on the same farm, showing some of the symptoms that the other cattle had shown before death, but was very much in doubt as to it being identically the same disease. Word was left with the owner, if the cow died, to notify the local inspector at once, and specimens would be taken for a second inoculation. The owner performed his part very faithfully, but the local inspector failed to report the case. About seven days after, Dr. O'Connell learned, through the commissioners of Hampshire County, that the cow had died on November 30; he proceeded at once to the farm of Brown & Avery, exhumed the carcass, and took sections of the spinal cord and shipped them to Dr. Frothingham. These specimens were, however, so decomposed that it was impossible to use them for inoculation purposes.

During the interval of the death of the last cow, September 18 to October 1, there were three or four more cows that died in an adjoining pasture, one belonging to Mr. Cameron and two to Mr. McElwain. Those cases were never reported by the local board of health or by the cattle inspector. All that is known about them is by hearsay; but it is said that their owners are to receive pay from the county commissioners out of the dog fund. The barns where these cattle were kept were ordered to be thoroughly washed with boiling water and bichloride of mercury, one part to five hundred of water. The carcasses of the animals were buried very deep, thereby preventing them from being eaten by dogs.

It is here recommended that all inspectors throughout the State, whenever such cases are reported to them, shall immediately notify the Cattle Commissioners; in fact, they are required to do so by law, as annoying complications are likely to ensue if local authorities are lax in co-operating with the Board of Cattle Commissioners in any cases that may prove to be contagious animal diseases.

In addition to the symptoms described above and the proof afforded by inoculating rabbits from the suspected cow, the cattle also had partly healed scars on the legs, such

as would result from the infliction of dog bites a few weeks previously.

In many instances so-called cases of rabies may be due to some other cause, and it is not unusual to call a dog mad and shoot him if he acts in a peculiar manner, when he may not have rabies. In doubtful cases it is much wiser to secure the dog safely until some one having knowledge of these matters can see him; and, if there is then any uncertainty, rabbits should be inoculated from the fresh medulla and cord, in order to establish a correct diagnosis. This is especially important if the dog has bitten any person or persons; as, if the animal is really rabid, the persons bitten should at once be sent to the Pasteur Institute, in New York, to undergo the protective inoculation for this fatal and terrible malady.

In questionable cases of rabies, reported to the Board of Cattle Commissioners, it has been considered wise to attempt to establish the presence or absence of the disease by having rabbits inoculated; and in a case similar to the outbreak at South Hadley, where the payment for cattle from the dog fund is involved, it becomes a very important matter to determine the exact nature of the trouble.

While it is possible a few of the cases reported to the Board of Cattle Commissioners during the past year were not rabid, yet in many outbreaks it has been proved by inoculation experiments that the diagnosis was correct, in one case that it was incorrect, and two results were neither positive or negative, owing to the decomposed condition of the material.

The following table shows the results of the inoculation proof of absence or presence of rabies: —

MONTH.	City or Town.	Animal.	Result.
January, .	Boston, . .	Dog,	Positive.
January, .	Boston, . .	Dog,	Positive.
January, .	Boston, . .	Dog,	Positive.
January, .	Waltham, .	Dog,	Positive.
January, .	Waltham, .	Dog,	Negative; dog ran from Salem to Auburndale; sent in by Dr. Peterson, inspector of Waltham; rabbits died of septicæmia.
March, .	Holyoke, .	Dog,	Positive.
August, .	Holyoke, .	Dog,	Negative.
August, .	South Hadley,	Cow,	Positive.
November,	Melrose, .	Dog,	Positive.
November,	Sudbury, .	Dog,	Positive.
December,	South Hadley,	Cow,	Negative, because material was not in condition to use; rabbits would have died of septicæmia.

The following table shows the number of cases reported during the year, either rabid, or suspected of being so: —

MONTH.	City or Town.	Animal.	Number of Cases.
January, ...	Boston, . .	Dog,	3
January, ...	Holyoke, .	Dog,	2
January, ...	Waltham, .	Dog,	2
February, ...	Holyoke, .	Dog,	3
March, ...	Holyoke, .	Dog,	1
May, ...	Lynn, . .	Dog,	1
July, ...	Boston, . .	Dog,	2
July, ...	Lynn, . .	Dog,	1
August, ...	Holyoke, .	Dog,	1
August, ...	South Hadley,	Cow,	2
September, ...	South Hadley,	Cow,	5
November, ...	Sudbury, .	Dog,	1
November, ...	Melrose, .	Dog,	1
November, ...	South Hadley,	Cow,	1
December, ...	Wakefield, .	Dog,	1
Total number of cases reported,	. . . . .	. .	27

Hog Cholera.

Hog cholera seems to be a term indiscriminately applied to any disease swine may be affected with, particularly if several in a piggery are sick at one and the same time.

True "hog cholera" is a specific disease of the pig, having

ulceration of the Peyer's patches of the intestine as a characteristic lesion.

"Swine plague," so called, is a septic pneumonia of the pig, and is sometimes produced by feeding upon decomposed swill. Cases have occurred where "swine plague" has been communicated from swine to horses, sheep, lambs and calves.

Boiling the swill, where city swill is fed, will kill the germs of "hog cholera" and of "swine plague," and after it cools, skimming the grease off the top has also been advised.

Sometimes, after cooking the swill, the pigs will show evidences of "swine plague;" this is probably due to the presence of ptomanes (chemical products of a poisonous character) that have been produced by the growth and development of the septic germs before the swill is cooked.

"Hog cholera" and "swine plague" may both be present in the same pig at the same time, or either may appear in a herd of swine without being associated with the other.

Another disease that has just been brought into notice by the issuing of a recent bulletin upon the subject by the Cornell University Agricultural Experiment Station, written by Dr. Veranus A. Moore, is the poisoning of swine by washing powders and strong alkaline soaps sometimes found in the swill of hotels and public institutions.

The name "hog cholera" is often used indiscriminately by the public in designating these maladies, and a number of cases are reported every year, usually during the winter and spring months.

About the only action necessary seems to be to quarantine the premises while the outbreak lasts, forbidding the sale of swine while any sick ones are left, and advising against the introduction of new ones into the infected herd; separating the sick and well; disinfecting the premises when the outbreak is over; and cooking the swill if it comes from city supplies or public institutions. When the outbreak is over, the quarantine is raised.

Tuberculosis is not at all uncommon among swine; it is usually discovered at the time of slaughter, and is seen chiefly among pigs kept under cow barns where there are tuberculous cows, or, if the cows are diseased, in pens where

the cleanings from the cow stable are thrown, or among pigs fed offal from tuberculous cattle.

For reports upon any lesions sent in for microscopic examinations to Dr. Frothingham, either "hog cholera" or porcine tuberculosis, see Dr. Frothingham's report to the commissioners.

Other Diseases.

In July an outbreak of a disease of an unknown and fatal character was reported from Edgartown. Dr. H. P. Rogers was sent to investigate the matter, July 16; later, he reported that three cows that had recently calved had died, and from what he could ascertain, he thought they had died of parturient apoplexy.

November 20, a ram was quarantined by the inspector at Chilmark, Martha's Vineyard. Dr. H. P. Rogers was sent to investigate this case also, the inspector believing the animal to have "sheep scab." Dr. Rogers reported, December 1, that the ram presented no evidence of "scab."

July 27, Mr. Freeman Hancock of West Tisbury wrote the Board concerning a bowel trouble that attacked members of his family, as the result of using milk from his cows, the first of it being in 1895. Dr. Madison Bunker of Newton was sent to investigate this matter, and made the following report: —

Newton, Mass., Aug. 8, 1897.

Dr. Austin Peters, *Chairman, Cattle Commission.*

Dear Doctor: — In accordance with your instructions, I went to West Tisbury this week and made a visit to the farm of Freeman Hancock.

I found this to be the state of affairs, viz.: at intervals since October, 1895, there has been trouble with milk from three different cows that have been in his pasture; this trouble has been in the spring and in the fall, when the feed has been most succulent and thickest. The milk has been thick when allowed to stand, and the cream would when handled hold together and be ropy like cold molasses, — no smell, no color, no taste.

It has caused diarrhœa in the whole family, with excessive nausea in a ten-months-old child, whose stools were very fluid and very dark green. The child nearly died before the cause was ascertained; as soon as the use of this milk was stopped, recovery came in all the cases. The local physician is said to have found pus in the milk.

A change of cows has been made twice, with cessation of the trouble for some weeks or months, and then a recurrence of the trouble.

The young cow of which Mr. Hancock spoke as having had the trouble lately, has been put in the next pasture, since which time there has been no trouble with her. He has still the old cow in the pasture, but he is raising calves on her, so does not know how her milk now is. I asked him to save some of her milk, try it and report to you. The pasture is a good pasture of the kind, not very rich nor very much run out; has been used for seventy years by this family, and is a part of the location upon which the settlers built when the land was bought from the Indians by William or Thomas Mayhew. There are from seventy to one hundred acres in it. I drove over and around it, but saw no growth or weed which would give me any clue to the trouble, with the possible exception of a strip of land bordering upon a pond, into which the sea breaks, but that is not open, upon which a blue grass grows, and which had been pretty well eaten down, but whether by the cows alone or by the sheep, I could not say.

The water supply is fresh and brackish; there are water holes around the fences, one or two close to this pond, the others one-quarter of a mile away, and then some not so far. Water at barn good and free from taste; drainage away from well. Samples of both cows' milk and of pasture and barn water were taken and sent to Dr. Frothingham; also Mr. Hancock's letter to you, with a request to report to you.

My idea of the trouble is that it is all within the pasture, as when changed from the pasture the milk is all right, also when in the barn. Cows are healthy and bag of old cow OK. Young cow I did not see, as she was some distance away.

I suggested to the owner that he watch his cow as to feeding grounds, and also tramp the pasture to find any weeds. No swamp, no brush in field to cause trouble or for her to browse on.

Yours very truly, MADISON BUNKER.

A few days later Dr. Frothingham reported upon the specimens brought by Dr. Bunker as follows: —

BOSTON, Aug. 13, 1897.

C. C. 77. — Milk and Water from Freeman Hancock, Martha's Vineyard.

From the report received, it seems more than probable that the trouble with Mr. Freeman's cows is referable to some poisonous substance existing in the old pasture. That this substance is of

bacterial origin is not probable, but rather some plant, the poisonous alkaloid of which is excreted in the milk. It would be next to impossible to discover the unknown alkaloid, even if the milk were chemically examined. It also seems unnecessary to undertake a detailed bacteriological examination of either milk or water.

A microscopical examination of the centrifugalized milk from the "old cow" shows a very limited number of pus cells, not enough to warrant a diagnosis of any suppurative process in the udder; less, in fact, than one often finds in the best milk.

FROTHINGHAM.

Mr. Hancock was written to, informing him of Dr. Bunker's and Dr. Frothingham's conclusions; and, as the trouble only appears when the cows are in a certain pasture, he was advised to keep them elsewhere, and use the pasture where the difficulty exists, for sheep.

At the same time, it would be interesting to know definitely what there is in this pasture that causes the milk to be unwholesome for human food, while the general health of the animals appears to be undisturbed.

Respectfully submitted,

AUSTIN PETERS, *Chairman,*
JOHN M. PARKER, *Secretary,*
MAURICE O'CONNELL,
LEANDER F. HERRICK,
CHARLES A. DENNEN,
Board of Cattle Commissioners.

Appendix A.

REPORT BY LANGDON FROTHINGHAM, M.D.V.

To the Massachusetts Board of Cattle Commissioners.

Gentlemen: — I herewith submit a report of my work from March 1 to Dec. 11, 1897. It has consisted of the examination of organs or portion of organs received from the inspectors or other agents of this commission. Where it was deemed necessary to establish the exact nature of a pathological change, not sufficiently evident by a macroscopic examination, a microscopic examination was resorted to, or inoculation. The specimens examined will be found classified in an appended table. Besides this, it has been my duty to establish the presence or absence of glanders and rabies in suspected cases by approved methods. Classified tables relating to these diseases are also appended.

Tuberculosis.

The number of tuberculous lesions has not been large, and they were, as a rule, not unusual. One case of marked tuberculosis of the larynx and one of tuberculosis of the trachea are rare, because perhaps, not often sought for. The most interesting specimens were those of miliary tuberculosis of the udder, of which there were three. Such cases are doubly interesting, since it is frequently impossible to differentiate them from other udder lesions before death, and even in some instances upon the autopsy table the existence of tubercles can only be suspected; yet the microscopic examination may show minute tubercles thickly scattered throughout the gland, and it is hardly possible to conceive that in such cases tubercle bacilli do not find their way into the milk.

Actinomycosis.

Actinomycosis of the udder, when the foci are small, may easily be confounded with tuberculosis, and a differential diagnosis is only possible by a microscopic examination. Two such cases have been examined. Actinomycosis of the lungs, when the lesions are small, may easily be mistaken for tuberculosis, if a macroscopic

examination alone is made. One such case is here reported. Only one other instance of this disease was received, and this the usual and easily diagnosticated tumor of the jaw (lump jaw).

Glanders.

The work in this direction has consisted in making a positive or negative diagnosis in suspected cases, according to the method of Strauss (the interabdominal inoculation of male guinea-pigs with suspected discharges). At first the material for inoculation was collected personally, but it was found more expedient for the inspector who visited such cases to obtain the suspected discharge, and bring it, as soon as possible, to the laboratory. It was, therefore, arranged that such inspector should carry with him the following: a test tube properly plugged with absorbent cotton, containing a swab of absorbent cotton wrapped about the end of a stout wire; the whole thoroughly sterilized before being placed in the inspector's hands. As much as possible of the suspicious discharge (nasal or from a farcy-bud) is collected upon this swab, at once returned to the test tube and brought to the laboratory. Here sterilized water is added, the cotton swab freed from the wire and left in the water. This is then violently shaken, until all large particles of the discharge are dissolved, the cotton squeezed as dry as possible with sterile forceps, and the solution thus obtained used for inoculation, two guinea-pigs being invariably employed. Unfortunately, the guinea-pig is not as susceptible an animal as one could desire for such work, but is the only accessible one, and if virulent glanders bacilli are present in sufficient number, the typical lesions of the testicle appear in from two to five days after inoculation. In only one instance of a positive inoculation were these lesions absent, and in this case cultures of the glanders bacillus were obtained from the spleen sixteen days after inoculation, when the animal was killed. A second guinea-pig, however, inoculated at the same time, showed the testicle lesions on the second day.

A glance at the annexed table may intimate a preponderance of negative results; but it must be remembered that these inoculations were undertaken for the purpose of diagnosis, and that these horses were only doubtful cases of glanders. The more suspicious negative cases were tested twice, to be doubly sure of the absence of glanders bacilli. One horse that gave a negative test was subsequently killed, and glanders nodules found in the lungs at autopsy; no lesions were found upon its nasal septum, however, and only a clear, watery discharge from the nose had been

obtained for inoculation. Several other negative tests were also made, where the discharge used was unsatisfactory. It is interesting to note that in all the positive inoculations the discharge was obtained from the left nostril, while in the negative inoculations the discharge was, in the majority of cases, from the right, or, as above stated, unsatisfactory. In only one positive case was a second inoculation necessary, and here because the pigs died about thirty-six hours after inoculation, of peritonitis, due to other organisms than the glanders bacillus present in the discharge.

A most interesting positive inoculation was from a man in Lynn. There was a clear history of his having a wound upon the hand, and of his constant attendance upon horses suspected of having glanders. When seen, the lesions of glanders upon the hand had healed to such an extent that it was impossible to obtain material for inoculation. At that time he had had these lesions and enlarged axillary glands for about three months. From a sluggish lesion upon the instep, however, a serous discharge was obtained, which, when inoculated into guinea-pigs, gave rapid and positive results.

Rabies.

But few cases of this disease have been investigated. They are classified in a special table. The most interesting was that of a cow, this animal being supposed to have been bitten by a dog some time before she showed symptoms of disease; and rabbits, inoculated according to the method of Pasteur, gave positive results. This cow was one where several others died in a herd at South Hadley, showing similar symptoms, and having scars of dog-bites on their legs.

Tables.

[It is assumed that, where an organ was tuberculous, the lympathic glands of that organ were also tuberculous. Hence in the following table only such glands are mentioned as were sent unaccompanied by other organs.]

Specimens Examined.

Cattle: —	
Aberrant supra-renal tissue in the kidney,	1
Abscess of liver,	9
Abscess of udder,	2
Adenoma of pancreas,	1
Actinomycosis of lung,	1
Actinomycosis of udder,	2
Actinomycosis of superior maxillary bone,	1
Angioma of liver	1

Ataleotasis,	1	
Atalectasis and bronchitis,	2	
Bronchitis (chronic),	2	
Cancer of omentum,	1	
Cysts of udder,	2	
Cysts of kidney,	1	
Dermoid cyst,	1	
Fat foci in liver,	1	
Fat foci in muscle,	1	
Foreign body in heart,	1	
Œsophagostoma,	2	
Nephritis (chronic),	1	
Mastitis,	3	
Multiple necrosis of liver,	1	
Pleuritis,	1	
Pneumonia,	12	
Tuberculosis of lungs,	8	
Tuberculosis of lungs and pleura,	4	
Tuberculosis of liver (peritoneal surface only),	2	
Tuberculosis of larynx,	1	
Tuberculosis of lymphatic glands (only glands sent),	5	
Tuberculosis of omentum,	1	
Tuberculosis of trachea,	1	
Tuberculosis of udder,	4	
Texas fever,	5	
	—	82
Swine: —		
Bronchitis and atalectasis,	1	
Hepatitis (chronic interstitial),	1	
Hog cholera,	2	
Hydronephrosis,	1	
Pericarditis (chronic),	1	
Pleuritis (chronic),	1	
Pneumonia and pleuritis,	1	
Pneumonia,	2	
Tuberculosis of lungs,	5	
Tuberculosis of liver,	3	
	—	18
Horses: —		
Fibro-cysto-adenoma of intestine,	1	
Glanders of lymphatic glands,	2	
Glanders of lung,	2	
Glanders of nasal septum,	2	
	—	7
Normal organs examined,	24	
Doubtful diagnosis,	3	
Decomposed,	3	
	—	30
Total of specimens examined,		137

Inoculations for Diagnosis of Glanders.

	Negative.	Positive.	
Inoculation of nasal discharge from suspected horses,	12	5	
Inoculation of discharge from supposed farcy-bud, .	3	3	
Inoculation of discharge from lesion on instep of man,	–	1	
	15	9	
			24

Rabies, 1897.

ANIMAL.	Town.	Rabbits Inoculated.	Appearance of First Symptoms.	Days Elapsed.
Newfoundland dog, .	Holyoke,	March 24,	April 6,	13
Pug dog, . . .	Lynn, .	June 4,	June 16,	12
Cow, ...	Holyoke,	August 31,	September 21,	21
French poodle, . .	Melrose,	November 13,	November 29,	16

Number of negative inoculations, ... 2
Still under observation, ... 3

Disposition of Tuberculous Animals and the Restriction of Tuberculosis in Cattle.

Your honorable Board has requested me to express an opinion as to the existing laws regarding the disposition of tuberculous animals and methods of restriction of tuberculosis in cattle.

Disposition of Tuberculous Animals.

According to the letter of the present law, if a single tubercle, not even the size of a pin's head, is discovered in the body of an animal, such animal cannot be used for food, but is consigned to the rendering tank; moreover, the State must pay the owner of such animal its full value. Such a law, it seems to me, sanctions wanton waste of excellent food, and is far removed from the ground principles of economic science. The laws of the most advanced European States have been the outcome of careful observation, practical experience and scientific study. For the most part, they are essentially the same as the United States law covering this subject, and for the State of Massachusetts I advocate a law more in harmony with these than the present one is.

The Restriction of Tuberculosis in Cattle.

Though feeling strongly that our existing laws relating to this much-debated subject are inadequate, I am, without much more careful thought and study, unwilling to suggest others.

The thorough science of the Germans is universally respected; their laws covering every grade of meat inspection are admirable, and the result of the best thought and scientific study of men well able, therefore, to dictate; yet at present there are no laws in Germany especially relating to the subject in hand. The nation is not idle, however, and is carefully watching and investigating the experiments in progress in other countries, and, as an eminent scientist of our own land has perhaps well said, when they do adopt measures for the restriction of tuberculosis in cattle they will probably be wisely economic, more efficacious and in every way better than have as yet been attempted. I, therefore, advocate wise delay and a careful study of the shortly forthcoming recommendation to the German government now being prepared by one who has recently returned from Denmark, where he was sent to make an exhaustive study of Bang's work, methods and results. In these recommendations we may find many valuable suggestions applicable to our country with but slight alteration. At least, they may offer us new and better lines upon which to proceed. Nothing is to be gained by extreme haste. Tuberculosis has been of very gradual growth in our cattle, and it is possible that its decrease and final control must be also a gradual process. The peculiar nature of the disease seems to indicate this; it is not an acute infectious disease, and, therefore, should not be treated as such.

Before proceeding too hastily, would it not be judicious to inquire thoughtfully into the cause of the present crusade against tuberculous cattle? I therefore suggest the following for careful consideration: —

Why the slaughter of so many tuberculous cattle and the waste of so much good food? If the answer to this question is that it is to protect human beings against tuberculosis, we must then consider the following questions: Are tuberculous cattle and their products a cause of tuberculosis in man? If so, to what extent? Are there not other causes far more dangerous, and hence much more important to control?

In partial answer to the above queries it may be said that, although many cases of tuberculosis in human beings are thought to be directly traceable to cattle, not one, in the vast literature upon the subject of tuberculosis, has been authentically established, so that this question is still an open one. On the contrary, it is universally acknowledged that tuberculous people, especially through their sputum, are an immense source of infection to other people and to themselves. That tuberculosis in man may, in some instances, be referable to tuberculous cattle, I firmly believe; but

this source of danger is greatly minimized, when we consider other possibilities of infection.

Careful and regular inspection of dairy herds by competent veterinarians is, in my opinion, a duty that the State should not ignore; but that the inspectors should limit themselves to the detection of tuberculosis only, I believe to be unwise. Various inflammatory and septic conditions of the udder, for instance, are acknowledged causes of bad, unwholesome milk; it is, therefore, evident that milk from such udders should never be used. Pure milk, however, is dependent upon the general health of the animals supplying it, and this, in turn, is dependent upon good hygienic surroundings. Bad hygienic conditions, again, are conducive to the spread of tuberculosis; hence, broad work in this direction would materially assist in reducing the amount of tuberculosis in cattle. Therefore, until manifestly sound laws for the direct suppression of tuberculosis in cattle are forthcoming, there is a wide field for energetic labor which indirectly will gradually be attaining a similar end.

Respectfully submitted,

LANGDON FROTHINGHAM.

APPENDIX B.

PRELIMINARY REPORT UPON A COMPARATIVE STUDY OF TUBERCLE BACILLI FROM MAN (SPUTUM) AND FROM CATTLE.

BY THEOBALD SMITH, M.D.

For a number of years past the writer has been impressed with certain differences in the lesions produced in the guinea-pig by the tubercular products of cattle, on the one hand, and by sputum from human beings containing many tubercle bacilli, on the other. These differences are not great, nor are they easily described; but they were of sufficient moment to induce the writer to attempt some experiments, to find out to what extent they depended on differences in the bacilli of human and of bovine tuberculosis, and whether such differences were of sufficient intensity to be brought out by the bacteriological and pathological methods in use.

A beginning was made in 1895 with a fresh culture of bovine tubercle bacilli and a fresh culture of bacilli from an animal (*Nasua narica*) which had lived with a tuberculous master. It was assumed then, and all evidence is in favor of the assumption, that this animal had been infected from its master, and that the tubercle bacilli obtained from it could be classed as human. The careful study of other sputum bacilli subsequently also supports this assumption. The experiments made with these cultures have been fully reported elsewhere,* but I shall include them in the summary of the work done more recently, as the methods pursued are the same, and the results therefore comparable. No opportunity was given to continue this work until this year (1897), when the Board of Cattle Commissioners offered to furnish me cattle and to provide the food for their maintenance during the period of the experiments. At the same time, the State Board of Health, fully cognizant of the important bearing of this work

* Transactions Association American Physicians for 1896, pp. 75-93; twelfth and thirteenth annual reports of the Bureau of Animal Industry, United States Department of Agriculture, p. 149.

upon the public health, authorized me to use its laboratory facilities, without which aid a further pursuit of the subject would have been impossible. Some of the work was also done in the newly established laboratory of comparative pathology of the Harvard Medical School.

A full report of this work, including a description of the method employed for cultivating the bacilli of tuberculosis, the preliminary experiments upon small animals (rabbits and guinea-pigs) and the microscopic study of the diseased tissues of the animals experimented upon, will be given at another time. In this report I shall restrict myself to that portion of the work having reference to the immediate relationship and differences between human (sputum) and bovine tubercle bacilli, as determined by experiments upon cattle.

Inasmuch as up to the time of the first experiment nothing was known of the effects of bovine tubercle bacilli inoculated into cattle, and very little, if anything, of the effects of tubercle bacilli from man inoculated into the same species, the methods of dealing with this subject had to be, as it were, developed during the course of the work. One thing, however, was deemed essential. The tests to be made with human and with bovine bacilli upon cattle must be conducted under as uniform conditions as were possible, under the circumstances. Only by showing differences in the action of tubercle bacilli from these two sources under the same conditions can we prove any actually existing differences in the bacilli themselves. Absolute uniformity was unattainable, but I think the records will show with few exceptions a uniformity in all important details.

In all cases the various cultures of tubercle bacilli were isolated by me. Cultures of unknown age and source, borrowed from others, were not employed. Products of the disease, tuberculous tissue from cattle, in one case from swine, and sputum from human subjects were inoculated into guinea-pigs, and from them, after three to six weeks, cultures on dog's serum were obtained. These were tested subsequently upon rabbits and guinea-pigs, and lastly on cattle.

The mode of testing the cultures upon cattle deserves a brief description. In all cases the growth on blood serum was stirred up in sterile bouillon until a clouded suspension was obtained, which corresponded in depth to a bouillon culture of typhoid or hog-cholera bacilli about twenty-four to thirty-six hours old. This was injected with a hypodermic syringe into the thoracic cavity through the right chest wall, the intent being to deposit at least a portion of the suspension in the lung tissue. This method

of introducing the bacilli was chosen because it was likely to furnish the most uniform conditions, and also because tuberculosis of the organs of the chest is the most frequent form of disease among cattle.

Experiment I. — This, as stated above, was made in 1895, with two cultures, one from an old bull, with advanced generalized disease, involving also some of the bones, the other from a tuberculous animal probably infected from its tuberculous master.

Two heifers were inoculated with these cultures, as described above. The one receiving the bovine culture died in thirty-five days, with miliary tuberculosis of the lungs and general tuberculosis disseminated throughout the body. The one receiving the presumably human culture showed no signs of disease, and when killed fifty-four days after inoculation, not even a local lesion could be traced.

Experiment II. — This experiment was carried out two years later, in 1897, and included four head of cattle. The tubercle bacilli were obtained from the following sources: —

Sputum culture II., from a rapid case of phthisis in New Bedford, Mass.

Sputum culture III., from a subsequently fatal case of phthisis in Norwood, Mass.

Bovine culture II., from an old cow slaughtered in Lawrence, Mass., in which there was slight disease of the lungs and mediastinal glands (specimens brought me by Dr. Alexander Burr).

Swine culture I., from swine living under a cow barn in Massachusetts (specimens obtained by Dr. Austin Peters). This culture in every way appeared identical with the bovine cultures, and this, together with the fact that the swine were exposed to infection from cattle, led me to assume that this was a bovine culture in origin.

On May 1, 1897, these four cultures were injected into four head of cattle. The total age of the cultures, or, in other words, the total period of time during which they had been growing on dog's serum, was as follows: —

Sputum culture II., five months, nine days old, eighth transfer.

Sputum culture III., two months, fifteen days old, fourth transfer.

Bovine culture II., five months, two days old, fifth transfer.

Swine culture I, eleven months, twenty-three days old, sixteenth transfer.

Assuming that tubercle bacilli become slowly weakened in virulence by artificial cultivation, we should endeavor to use cultures as fresh and of as nearly the same age as possible. This

theoretical demand cannot be successfully met, because of the many difficulties surrounding such work. Of the four cultures used, sputum II. and bovine II. are of nearly the same age, while sputum III. is but half as old as they, and swine I. more than twice as old. In making the injection, the space between the sixth and the seventh rib was chosen. The needle was inserted about three inches above the level of the elbow (olecranon process). It was found subsequently at the autopsy that the point chosen was too low, and that in all of the animals the needle, leaving the lungs intact, pierced the diaphragm. Some of the bacilli were thus discharged into the abdominal cavity.

Bearing this unforeseen accident in mind, we may now go to a description of the further history of the inoculated cattle. They were all housed in a spacious, well-ventilated barn, in large, commodious horse stalls. A piece of ground adjoining the barn was enclosed, and in this the animals spent six to seven hours a day for about four weeks. Thereafter the animals were separated into two lots, one lot being out several hours in the morning, the other several hours in the afternoon. The two which received the bovine and the swine culture were allowed to run together, similarly the two which received the sputum cultures. It might be claimed that there was in this arrangement a possible danger of transmitting the bacilli from one animal to another, and of infecting the ground. There was no evidence of this at the post-mortem examination; and the arrangement was considered safe at the start, because it takes some time for the tuberculous tissue to become disintegrated. Only when this has set in can we consider the passage of bacilli from one animal to another possible. It was, however, deemed prudent not to keep the animals longer than two months, on account of the imperfect isolation.

In apportioning the cultures to the animals, the sputum cultures were injected into the youngest animals, in order that these cultures might have any advantage likely to accrue from differences in age. Two yearlings (without any permanent incisor teeth) received the two sputum cultures, the bovine culture was injected into a heifer about two and one-half years old, the swine culture into a heifer about two years old.

They were killed and examined at the Brighton abattoirs, with the co-operation of the Board, just two months after the day of the injection. Before inoculation these animals had been tested with tuberculin by the Board, and found free from tuberculosis. Still, since this agent occasionally allows an animal to escape which contains foci of the disease, attention was directed to this point at the autopsies. No lesion, however, was found, which

from its situation and appearance could be referred to any former spontaneous infection.

Let us examine first the effect of sputum culture II. and bovine culture II. which were of nearly the same age when injected.

The weight of the yearling (2616) receiving the sputum culture had risen in the two months from 520 to 580 pounds, that of the heifer (2635) from 650 to 710 pounds. There was no continuous fever recognized in either animal, though the temperature was taken twice a day, morning and afternoon. The fluctuations noticed were evidently due to the effect of the sun while the animals were in the enclosure.

The lesions in the yearling (2616) were very slight. At the seat of inoculation, between the sixth and seventh ribs, a mass of tubercles attached to pleura about one by one-half inch dimension, the tubercles composing it partly cheesy, partly firm. Near cephalic border of ventral lobe of right lung, a sub-pleural nodule, not yet necrotic, about one-eighth inch in diameter. On abdominal aspect of diaphragm, right side, about twenty-four isolated tubercles, each one-twelfth to one-eighth inch in diameter, uniformly yellowish in color. A few similar tubercles on the omentum. Slight adhesion of omentum. When adhesion removed, about six or seven nodules found on cæcum, one-twelfth inch in diameter. Evidently the injection needle had passed through diaphragm into abdomen, deposited some fluid there and some in thorax when partly withdrawn.

The lesions in the heifer which had received the bovine culture were quite extensive, and were diffused through thorax and abdomen, owing to the penetration of the diaphragm by the needle of the injection syringe: —

Thorax: The right pleural cavity shows an abundant eruption of tubercles along the lateral margin of the ribs. Some of the masses formed are characteristically flattish, grape-like, and in bulk quite large. One mass measured eight by three by one inch. Others of similar dimensions were present. On the lateral margin of the right lung a series of loosely attached flattish neoplasms, up to two inches in diameter, besides hyperæmic fringes of loose connective tissue. On the convex surface of this lung only a few tubercles. Large patches of tubercles on pericardium and diaphragm.

In the muscular portion of diaphragm, right side, a mass of tuberculous tissue (probably place where needle penetrated), one and one-half by one and one-half by one-half inch in dimension. The most caudal of the series of dorsal mediastinal glands about twice normal size, on account of the presence of many small foci, showing in some cases an opaque, yellowish centre.

Abdomen: The omentum densely studded with agglomerations of tubercles, covering the greater part of its surface. These masses vary

up to one-half inch in thickness. Similar patches on abdominal aspect of diaphragm and on spleen. Fewer patches on gall bladder and on the liver. In one of the portal glands a one-quarter inch focus, pale, grayish, permeated with small, calcareous spicules.

We have in these cases a wide divergence in the result of the inoculation. The human bacillus produced a slight eruption of small, tubercle-like bodies, which did not even present microscopically the characters of true tubercles; while the bovine bacillus produced an exquisite case of pearly disease both in thorax and abdomen, with the formation of large, grape-like masses in the chest. These, under the microscope, presented all the characters of genuine tubercles, and contained tubercle bacilli.

The youngest sputum culture (No. III.) was injected into a yearling weighing 410 pounds. At the end of two months the weight had risen to 480 pounds. The lesions found are slight: —

On the abdominal aspect of diaphragm, right side, a patch of isolated tubercles about two inches in diameter, the tubercles themselves about one-sixth inch diameter, and about one-half inch apart. They are grayish, opaque. At place of inoculation, on serous aspect of ribs a flattish neoplasm, one inch in diameter and about one-eighth inch thick. Other lesions not detected.

In this case also the needle evidently entered abdomen through diaphragm. The notes show very little disturbance as the result of the inoculation.

The swine culture was injected into a somewhat older animal, weighing 620 pounds. After two months the weight was 660 pounds. The autopsy showed the following condition: —

At place of inoculation (right chest wall) a subcutaneous tumor about two inches in diameter, made up of a very dense connective tissue sac one-quarter inch thick, and which encloses a pale, yellowish semifluid mass. . . . There are besides this focus in the same situation three smaller nodules, from one-half to three-fourths inch in diameter, the largest with caseous centre. On the pleural aspect a similar one-half inch centrally softened focus.

In nearly the centre of the right half of diaphragm and projecting into abdomen for one-half inch is a tumor representing a portion of a larger focus in the muscular portion of the diaphragm about one inch in diameter. This focus is likewise caseous diffluent centrally. On all the ribs of right pleural cavity are eruptions of small tubercles, reaching in some instances a diameter of one-eighth inch. Besides the palpable tubercles there is along one border of each rib a line of vascular fringes of connective tissue. In many of these fringes tubercles not noticed, although the fringes themselves are evidently a result of the injection.

Along the lateral border of the right lung similar vascular fringes of tissue containing tubercles. These fringes extend dorsad for about two inches on ventral and cephalic lobes.

Diffuse eruption of minute tubercles on pleural aspect of diaphragm, right half.

Large caudal mediastinal gland contains large numbers of tubercles, varying in size from mere points to those one-eighth inch in diameter, and showing beginning necrosis. Left bronchial gland several times normal size. Ventral mediastinal gland several times normal size, and containing several large centrally caseous foci. One mesenteric gland contains several small necrotic tubercles.

In this case many of the bacilli had been deposited in the fleshy portion of the diaphragm and some under the skin, and they were thus prevented from exerting their greatest power; nevertheless, the lesions are quite severe. It is not improbable that this culture would have been much more destructive had it been used six or seven months earlier.

Experiment III. — This comprised six head of cattle. The details of the experiment do not differ from those of experiment II. The animals had been tested with tuberculin under the direction of the Board.

The cultures of tubercle bacilli used in these tests were from cases of human and bovine disease, and comparatively fresh: —

Sputum culture IV., six months, ten days old, from a case of phthisis in Melrose, Mass. Patient was subsequently reported recovered.

Sputum culture V., one month, nineteen days old, from a case of phthisis of about two years' standing (New Hampshire).

Sputum culture VI., one month, twelve days old, from a case of phthisis in Winthrop, Mass.

Bovine culture III., four months, seven days old, from a cow with advanced lesions of lungs and liver (probably from Carlisle, Mass.).

Bovine culture IV., four months, three days old, from a cow with slight disease of mediastinal glands.

Bovine culture V., four months, three days old, from a cow with moderate disease of the lungs and portal gland.

This set of cultures is thus younger than the preceding set, with odds in favor of two of the sputum cultures. The bovine cultures were of nearly the same age.

The animals at my disposal were, unfortunately, not of the same age, and in assigning the cultures the advantage was given to the human cultures: —

Sputum IV., yearling, 525 pounds, no permanent incisor teeth.
Bovine III., yearling bull, 645 pounds, no permanent incisor teeth.
Sputum V., cow, 675 pounds, about four years old.

Bovine IV., cow, 850 pounds, about twelve years old.
Sputum VI., cow, 865 pounds, about three and one-half years old.
Bovine V., cow, 875 pounds, about six years old.

The injection of the cultures was carried out as in experiment II., excepting that the point of insertion of the needle was chosen higher up, about eleven inches above the elbow of the animal when in the standing position. The length of the needles used was about two inches.

The care of the animals was the same as that bestowed on the preceding lot, excepting that the bovine and the sputum animals were kept separate in the out-door enclosure from the start, the one lot being out in the morning, the other in the afternoon. They were kept two months, with the exception of the young bull (bovine culture III.), which died seventeen days after the inoculation. The four cows of this lot gave at the start altogether about eight quarts of milk. The amount slowly diminished, until in the sixth week a very little, amounting perhaps to one quart in two days, was removed. The milking was continued chiefly to prevent any udder troubles during the experiment, and to maintain normal conditions. The temperature was taken but once a day, at noon.

In comparing the temperature records of these six animals, it was noticed that the three animals which received the bovine cultures had a high temperature immediately after the inoculation, which lasted until the death of the bull and about three weeks for the remaining two animals. At the same time, no such elevation of temperature was recorded for the animals receiving the three sputum cultures. There was but one well-defined rise of temperature in case of the yearling, from the thirteenth to the sixteenth day after inoculation. The other irregularities are probably due to the fact that the temperature was usually taken after these animals had been in the enclosure in the sunshine for several hours. Those with the high temperature were kept much of the time in the cool barn in the morning, which probably depressed the fever curve somewhat. These temperature records are given at the end of this article. After the period of fever no other elevations were noted up to the close of the experiment.

The young bull, inoculated with bovine culture III., showed, besides the prompt onset of a high temperature, general and local disturbances about a week after the inoculation. The breathing became rapid, the appetite had partly gone. Emaciation and weakness supervened. He was unable to get up September 11, and died the following night.

The autopsy revealed a severe miliary tuberculosis of both lungs, with marked congestion and œdema of the organ. Normal collapse no longer possible. The associated lymph glands were much enlarged and infiltrated with minute tubercles. Patches of minute tubercles were found on the pleural covering of ribs and on the omentum. In the liver many minute tubercles were found in sections. In these, as well as in the tubercles of the lungs and mediastinal glands, tubercle bacilli were very abundant. The other organs have not yet been examined microscopically.

On October 27, the remaining five animals were killed at the Brighton abattoirs, with the co-operation and assistance of the Board.

The three sputum animals had all gained in weight: —

Yearling (sputum IV.), from 525 to 610 pounds.
Cow (sputum V.), from 675 to 750 pounds.
Cow (sputum VI.), from 865 to 960 pounds.

No. 79 (sputum culture IV.). — Yearling. One permanent incisor on the right has appeared since date of inoculation. In utero a fœtus about three months old. At point of inoculation in the subcutaneous tissue a small nodule about one-quarter inch diameter, with contents soft, cheesy. Attached to this is another smaller nodule, about one-eighth inch diameter.

On the right side of chest wall, pleural aspect, there are attached along the six caudal ribs, soft, dark-red, pendulous masses of newly formed connective, highly vascular tissue. At point of inoculation, between seventh and eighth ribs, a flattish pedicled mass of tissue of brownish-red color. On the tenth rib another mass, about three-eighths inch diameter. The left side of thorax is normal.

Right lung: On the small (cephalic and ventral) lobes newly formed, delicate fringes of hyperæmic connective tissue, which appears along the free lateral margin as a delicate band about one-half inch broad, as well as on a portion of the surface of the lung, occupying exclusively the lines representing the boundaries of the lobules.

In the large caudal lobe, which is similarly beset with the vascular fringes, a tumor, representing the place where needle penetrated lung tissue, projecting slightly above the convex surface, is found two inches from the caudal tip. This tumor, about three-quarters inch in diameter, contained a completely disintegrated mass and about a dozen foci, one-sixteenth to one-eighth inch in diameter, with yellow softened centre. On the margin of this same lobe, in addition to the vascular fringes are four firm masses of grayish tissue, smooth, flattish, attached by pedicles to margin of the lobe Their largest diameter is from one-quarter to one-half inch.

On large (caudal) lobe of left lung there is only a very little development of vascular fringes. Imbedded in the same lobe near lateral margin is a uniformly grayish, slightly translucent mass, sharply defined from the enveloping normal lung tissue.

Attached to the cephalic lobe of the left lung by a pedicle is a small, flattish, smooth mass of new tissue.

The pleural aspect of diaphragm and portions of the pericardium are covered with areas of the highly vascular, neoplastic tissue. In some, small nodules can be felt at the free extremity of this tissue.

On the right ventricular surface of the heart four flattish pedicled masses, about as large as split peas, are attached.

The various lymph gland systems, ventral and dorsal mediastinal and bronchial glands, do not show the presence of tubercles or any augmentation of size.

No. 39 (sputum culture V.). — Cow about four years old. In utero a fœtus three to four months old.

Development of vascular fringes along one border of ribs of the right side of thorax, as in preceding case, but amount slight, compared with that case. In the intercostal muscles at the point of inoculation a mass of perhaps a dozen small, grayish tubercles.

Right lung: In the large caudal lobe, in the same situation as preceding case, a projecting tumor about one inch in diameter. When incised it is found composed of two one-half inch foci of disintegrated cheesy-viscid matter, enclosed in thin, smooth capsules. No surrounding infiltration.

Along the margin and on the caudal surface of this lobe slight development of pendulous vascular tissue and a sessile tubercle about three-sixteenths inch diameter. On the left caudal lobe only very slight production of vascular tissue.

On the surface of one of the middle dorsal mediastinal glands an aggregation of minute tubercles one-half inch in diameter. Imbedded in the cortex of the same gland two minute tubercles.

No. 76 (sputum culture VI.). — In utero a fœtus about four months old.

Within the thorax, on the right side, between the seventh and eighth ribs, is a small, pedicled, blackish (hemorrhagic) mass of firm tissue about as large as a pumpkin seed, another on the tenth rib. On most of the ribs behind the seventh are gelatinous-looking pendulous vascular fringes of neoplastic tissue. On the pleural surface of the diaphragm a similar development of vascular tissue and several firm pedicled masses like those on ribs.

Of the right lung the cephalic lobe shows very slight formation of marginal fringes. In the ventral lobe, whose tip is adherent to the pericardial fat, a uniformly grayish, sharply defined focus, one-quarter inch in diameter.

In the same situation as in the preceding cases the caudal lobe shows a slightly projecting tumor, about one and three-quarters inches in diameter externally. When incised it is found to consist of a smooth-walled sac, one and one quarter inches diameter, containing a yellowish curdy mass, together with a little turbid fluid. No surrounding infiltration. On the convex surface of this lobe there is a slight growth of vascular tissue. Near the caudal tip a flattish mass, partly yellowish, partly blackish, attached by loose tissue to the margin of the lobe.

In the abdomen, a flattish, sessile mass of pinkish gray tissue, about three-quarters of an inch in its longest diameter, attached to omentum *

Of the three animals receiving bovine tubercle cultures, the fate of one (young bull No. 71) has already been given. The two other cases remained stationary in weight: —

No. 88, original weight, 850 pounds; weight at end of experiment, 850 pounds.

No. 63, original weight, 875 pounds; weight at end of experiment, 970 pounds.

The autopsy notes are in brief as follows: —

No. 63 (bovine culture V.). — White cow, spotted with red. Horns sawed off. Probably six years old. Fœtus in utero, about two months old.

Thorax: Right lung adherent to chest wall in several places. At point of inoculation, between seventh and eighth ribs, an excrescence, about three-quarters inch in diameter, of dense, pearly-looking connective tissue, enclosing a disintregated mass. Numerous masses and aggregations of small tubercles on all ribs; these in some cases several inches in length. The left side of thoracic wall, below the level of the point of inoculation on the opposite side, is covered with a uniform, pinkish-gray deposit of very minute tubercles. Eruptions of tubercles on pleural surface diaphragm and on pleural covering of dorsal mediastinal space.

On caudal lobe of right lung a considerable number of tubercular masses, flattish, sessile, from one-eighth to three-quarters inch in diameter. Between the cephalo-lateral border of this lobe and the pericardium is a mass of newly-formed tissue, dense, in which are imbedded many minute yellow tubercles and masses of pericardial fat. The whole is about as large as a fist. It binds the lung tissue, pericardium and diaphragm together.

Many tubercles on the caudal surface of this same lobe.

There is no distinct focus in this lobe, as a result of the injection, and it is probable that much of the fluid was deposited in the pleural cavity. But palpation reveals throughout both lungs small shot-like bodies, in close proximity. On section numerous yellow tubercles from one-thirty-second to one-sixteenth inch in diameter are found imbedded in the lung tissue of all lobes.

The dorsal mediastinal lymph glands are all several times normal dimensions. They contain many coalescing yellow tubercles. The ventral (anterior) mediastinal glands are similarly enlarged, and the cut surface shows a uniformly cheesy parenchyma.

Minute grayish points under the capsule of the liver.

* The character of these peculiar formations will be described in a subsequent report.

In the spleen, all malpighian bodies converted into tubercles with yellow, opaque centre. In left kidney several minute grayish tubercles.

No. 88 (bovine culture IV.). — Red and white cow. Teeth very much worn; probably twelve years old; dehorned. Not pregnant.

Thorax: No deposit at point of inoculation. The eruptions of tubercles on the costal pleura of the right and the left side are in character very much like those of the preceding case (No. 63), but less extensive.

Right lung: Lobes adherent to pericardium. Adhesions readily severed. On convex surface of the caudal lobe of this side a considerable number of flattish sessile tubercles, from one-sixteenth to one-half inch broad. The caudal aspect of this lobe is similarly beset with them, but in less abundance. Along the margin of this lobe are loosely attached small elongated masses of tubercles

At the same situation in this lobe as in the sputum cases there is a fluctuating tumor, about two inches in diameter, slightly projecting. It consists of a capsule with nearly smooth walls, enclosing a soft caseous mass. It is surrounded by a zone of small necrotic tubercles, and with lobules containing numerous minute grayish foci.

On the cephalic lobe of the right lung a considerable number of grayish tubercles. Throughout all lobes are many tubercles in the lung tissue, some very minute, others larger and opaque, yellowish in color.

The pleura in the dorsal mediastinal space is beset with a large number of small tubercles, similarly the pericardium. The right half of the diaphragm is beset with flattened aggregations of tubercles. Between the ventral lobe of the right lung and the pericardium, and fastening them together, is a mass of newly formed connective tissue and fat, enclosing numerous softened foci.

The large dorsal mediastinal lymph gland is enlarged, and contains a large number of yellow tubercles. The central portion of the gland is uniformly caseous. In the left bronchial gland, a small number of tubercles; in the ventral mediastinal glands, a considerable number.

Organs of the abdomen appear free from visible tuberculous changes.

A summary of the outcome of this last experiment may now be made.

The points of difference between the inoculation disease produced by bovine and by human (sputum) bacilli are several: —

1. The bovine cases either remained stationary in weight or lost slightly, while the sputum cases gained seventy-five to eighty-five pounds. Still, the age of one of the bovine cases may be partly responsible for stationary weight.

2. There was marked fever in the bovine cases for three weeks after the inoculation, practically none in the sputum cases.

3. There were well-marked differences in the lesions produced. In the sputum cases the lesions are practically the same, and consisted in: —

(*a*) A tumor in the right caudal lobe of the lungs, about one inch in diameter, projecting somewhat above the surface of the lung. This

represents the place where the needle penetrated into the lung tissue and deposited the tubercle bacilli. In each case the contents of this tumor were softened and converted into a curdy mass, enclosed in a thin-walled capsule, smooth internally. The disease was not spreading from this point, nor were tubercles visible in the lymph glands of the lungs and thorax, excepting in one gland of No. 39.

(*b*) The free margin of the right lung, the pleural covering in part and the pleural covering of the ribs on the right side were beset with a new formation of loose vascular fringes or shreds, in which in only one case some minute nodules could be felt, also some flattish pedicled masses, not resembling tubercles.

Among the bovine cases we have the following characteristic points to note: —

(*a*) Disseminated tuberculosis of the lungs, severest and fatal in No. 71, the youngest, least pronounced in the oldest, No. 88. Associated with this, a local disintegrated focus in the lungs of No. 88.

(*b*) Tubercular deposits on lungs, pericardium and diaphragm, and the ribs, resembling closely the product of the natural disease in cattle. The few pedicled masses attached to the pleura in the sputum cases bore no direct resemblance to tuberculous outgrowths, although they are undoubtedly the result of the inoculation.

(*c*) Extensive tuberculosis of all or nearly all the lymph glands of the thorax, including both mediastinal chains.

(*d*) Tuberculosis of other organs, spleen, liver, kidney, in two out of three cases.

A summary of the three separate experiments, in which 12 animals were used, shows that: —

6 animals were inoculated with human bacilli.
5 animals were inoculated with bovine bacilli.
1 animal was inoculated with swine bacilli.

Of the 6 sputum cases: —

1 showed no disease.
2 showed very slight lesions.
3 showed only local lesions without dissemination

Of the 5 bovine cases: —

2 died of generalized disease.
2 showed extensive lesions.
1 showed less extensive lesions.

In the swine case (probably originally bovine) the lesions were less extensive than in the bovine cases.

In these three experiments the conditions were kept as nearly uniform as was possible, with the means at my disposal. It was unfortunate that an animal as old as No. 88 (bovine IV.) should have been included; it is also to be regretted that the swine culture was about a year old when used upon cattle. Undoubtedly the total absence of any lesions following the injection of the *Nasua* culture is partly due to the age of the culture. Leaving these aside, the remaining parts of the test appear to me to be of sufficient uniformity and accuracy to justify us in drawing certain preliminary inferences. We may now maintain that bovine tubercle bacilli and human bacilli as found in sputum are not identical. The difference in their action upon cattle is reinforced by certain differences in the bacilli themselves and their effect upon rabbits, as will be detailed in a fuller report.

What the significance of these divergencies is, what influence they have upon the transmissibility of the disease from cattle to man, we are unable at present to state with any degree of certainty. That they do have some effect must be admitted, in view of results of studies upon other species of pathogenic bacteria. Their precise bearing needs careful investigation.

These studies will, I think, warrant one inference, however; that is, that human sputum cannot be regarded as specially dangerous to cattle, nor can it be looked upon as a factor in the introduction of tuberculosis into a healthy herd of cattle. Even if the tubercle bacilli of cattle and of man are very closely related and have the same ancestry, as we all must admit, if we regard the two as mere varieties, which may eventually under very favorable conditions pass one into the other, the condition in which the bacillus leaves the lungs in sputum is evidently such as to interfere, *under ordinary circumstances*, with any development in the bovine body. It would fall a speedy prey to destruction.

I refrain, for obvious reasons, from drawing the conclusions that all human tubercle bacilli are like those existing in the sputum of phthisis. On this point we are still in the dark.

The following pages give a concise tabular account of the cultures employed in these investigations, of the animals upon which they were tested and the temperature records of the third experiment. Those of the second experiment, as stated above, reveal no essential differences between the different animals, and are therefore omitted.

Table I.

Designation of Culture.	Source of Culture.	Date when Artificial Cultivation began.	Date of Inoculation into Cattle.	Total Age of Culture. Months.	Total Age of Culture. Days.	Number of Transfer.
Bovine I.,	Old bull (Virginia). Extensive disease, probably of long standing; bones infected.	Dec. 1, 1894,	May 4, 1895,	5	4	3d.
Nasua narica (human sputum),	Household pet of phthisical patient (Washington, D. C.).	July 26, 1894,	May 4, 1895,	9	9	8th.
Sputum II.,	Rapid case of phthisis (New Bedford, Mass.),	Nov. 21, 1896,	May 1, 1897,	5	9	8th.
Sputum III.,	Fatal case of phthisis (Norwood, Mass.),	Feb. 15, 1897,	May 1, 1897,	2	15	4th.
Bovine II.,	Old cow with slight lesions of lungs and mediastinal glands (Lawrence, Mass.).	Nov. 28, 1896,	May 1, 1897,	5	2	5th.
Swine I.,	Pig, living under cow barn (Framingham, Mass),	May 8, 1896,	May 1, 1897,	11	23	16th.
Sputum IV.,	From case of phthisis, subsequently reported as recovered (Melrose, Mass.).	Feb. 16, 1897,	Aug. 26, 1897,	6	10	7th.
Sputum V.,	From a stationary case of phthisis (New Hampshire),	July 7, 1897,	Aug. 26, 1897,	1	19	3d.
Sputum VI.,	From a case of phthisis (Winthrop, Mass.), subsequent history unknown.	July 14, 1897,	Aug. 26, 1897,	1	12	3d.
Bovine III.,	Cow with advanced tuberculosis of lungs and liver (Carlisle (?), Mass.).	April 19, 1897,	Aug. 26, 1897,	4	7	5th.
Bovine IV.,	Cow with slight disease of dorsal mediastinal glands (Billerica, Mass.).	April 23, 1897,	Aug. 26, 1897,	4	3	5th.
Bovine V.,	Cow with moderate lesions of lungs and portal gland (Carlisle, Mass.).	April 23, 1897,	Aug. 26, 1897,	4	3	5th.

TABLE II.

Amount of Suspension of Bacilli injected.	Designation of Culture.	Age of Culture used.	Designation of Animal.	Age, etc.	Original Weight.	Final Weight.	Date of Inoculation.	Result.
		Days.			Pounds.	Pounds.		
4 cc., . .	Bovine I., .	10	No. 284,	Heifer, 2½ years old; common stock, pregnant.	?	?	May 4, 1895, .	Died in thirty-five days, of general miliary tuberculosis.
4 cc., . .	*Nasua narica*,	10	No. 300,	Heifer, 2½ years old, . .	?	?	May 4, 1895, .	Killed June 27, 1895; no lesions.
2 cc., . .	Sputum II., .	9	No. 2616,	Yearling, ...	520	580	May 1, 1897, .	Killed July 1, 1897; lesions very slight
2 cc., . .	Sputum III., .	9	No. 2634,	Yearling, ...	410	480	May 1, 1897, .	Killed July 1, 1897; lesions very slight.
2 cc., . .	Bovine II., .	9	No. 2635,	Heifer, 2½ years old, . .	650	710	May 1, 1897, .	Killed July 1, 1897; extensive pearly disease in thorax and abdomen.
2 cc., . .	Swine I., .	13	No. 2672,	Heifer, 2 years old, . .	620	660	May 1, 1897, .	Killed July 1, 1897; well marked pleural tuberculosis, with invasion of lymph glands.
2 cc., . .	Sputum IV., .	9	No. 79,	Yearling, about 1½ years old.	525	610	Aug. 26, 1897, .	Killed October 27; abcess in lungs at point of injection, new vascular tissue on ribs and lungs.
2 cc., . .	Sputum IV., .	9	No. 39,	Cow, 4 years old, . .	675	750	Aug. 26, 1897, .	Killed October 27; lesions same as preceding.
2 cc., . .	Sputum VI., .	9	No. 76,	Cow, 3 years old, . .	865	950	Aug. 26, 1897, .	Killed October 27; lesions same as preceding.
2 cc., . .	Bovine III., .	9	No. 71,	Bull, yearling, . . .	645	575*	Aug. 26, 1896, .	Died September 12; miliary tuberculosis of lungs, liver.
2 cc., . .	Bovine IV., .	9	No. 88,	Cow, about 12 years old, .	850	850	Aug. 26, 1897, .	Killed October 27; many minute tubercles in lungs, tuberculous deposits on pleura.
2 cc., . .	Bovine V., .	9	No. 63,	Cow, about 6 years old, .	875	870	Aug. 26, 1897, .	Killed October 27; disseminated tuberculosis of lungs and spleen.

* Two days before death.

TABLE III.

DATE.	Bovine Series (Number of Animal).			Sputum Series (Number of Animal).			Remarks.
	71	88	62	29	76	79	
	Temp.	Temp.	Temp.	Temp.	Temp.	Temp.	
Aug. 24, 11.30 A.M.	101.4	101.2	101.8	101.8	100.0	102.0	- -
25, 11.30 "	101.2	101.8	101.8	101.2	101.8	101.2	- -
26, 1 P.M.	102.8	101.4	101.6	101.8	101.4	100.8	Inoculation 9.10 A.M.
27, 1 "	104.6	102.6	105.4	101.8	103.8	102.6	- -
28, 1 "	104.0	101.6	105.2	102.0	102.4	102.4	- -
29, . .	-	-	-	-	-	-	- -
30, 1 P.M.	103.4	106.0	104.2	101.4	101.8	102.6	- -
31, 1 "	102.8	108.0	105.0	101.2	102.0	102.8	B.* Probably out in morning to date although record not kept.
Sept. 1, 1 "	103.4	105.6	104.0	102.4	103.8	102.0	S.† Out in morning.
2, 1 "	102.0	103.4	103.2	101.2	101.0	101.4	- -
3, 1 "	103.2	101.0	103.2	101.8	101.4	101.2	S.† Out in morning.
4, 1.30 "	105.4	103.4	104.4	101.0	100.6	100.8	S.† " "
5, . .	-	-	-	-	-	-	- -
6, 1 P.M.	107.0	100.8	102.2	100.6	100.8	101.0	- -
7, 1 "	106.6	101.2	105.6	100.4	100.6	100.6	B.* Out in morning.
8, 1 "	107.8	102.4	102.8	101.2	101.0	102.0	S.† " "
9, 1 "	107.2	105.4	104.6	101.4	101.4	102.6	S.† " "
10, 1 "	107.0	104.4	103.0	102.0	102.4	104.4	S.† " "
11, 1 "	104.8	105.0	104.0	101.4	101.2	101.6	S.† " "
12, . .	-‡	-	-	-	-	-	- -
13, 1 P.M.	-	103.0	102.0	101.0	101.2	101.6	S.† Out in morning.
14, 1 "	-	102.4	102.6	101.4	101.0	102.6	S.† " "
15, 1 "	-	101.0	101.8	101.0	101.4	102.0	S.† " "
16, 1 "	-	101.4	101.0	101.6	102.0	102.6	S.† " "
17, 1 "	-	100.4	100.4	100.8	101.4	101.6	S.† " "
18, 1 "	-	99.8	99.8	101.6	101.4	102.4	S.† " "
19, . .	-	-	-	-	-	-	- -
20, 1 P.M.	-	100.0	100.6	101.2	101.2	101.8	S.† Out in morning.
21, 1 "	-	99.8	100.6	101.0	101.2	101.6	S.† " "
22, 1 "	-	99.2	99.0	101.2	100.8	101.6	S.† " "
23, 1 "	-	99.8	101.0	101.0	101.2	101.6	S.† " "
24, 1 "	-	100.4	100.4	101.2	101.6	102.0	S.† " "

* Bovine case. † Sputum case. ‡ Dead.

TABLE III. — *Concluded.*

DATE.			Bovine Series (Number of Animal).			Sputum Series (Number of Animal).			Remarks.		
			71	88	62	29	76	79			
			Temp.	Temp.	Temp.	Temp.	Temp.	Temp.			
Sept. 25,	1	P.M.	–	100.4	99.8	101.2	101.8	101.8	S.†	Out in	morning.
26,	.	.	–	–	–	–	–	–		–	–
27,	1	P.M.	–	100.4	98.4	101.0	100.8	101.4	S.†	Out in	morning.
28,	1	"	–	100.2	100.6	100.4	100.8	101.8	S.†	"	"
29,	1	"	–	98.8	99.0	100.8	101.0	102.0	S.†	"	"
30,	1	"	–	101.4	100.4	101.0	101.6	101.6	S.†	"	"
Oct. 1,	11.45	A.M.	–	99.8	100.6	100.8	101.0	101.8	S.†	"	"
2,	1	P.M.	–	99.2	100.0	101.0	100.8	101.8	S.†	"	"
3,	.	.	–	–	–	–	–	–		–	–
4,	1	P.M.	–	99.0	99.0	100.0	100.6	101.8	S.†	Out in	morning.
5,	1	"	–	99.4	100.2	101.0	101.0	101.8	S.†	"	"
6,	1	"	–	99.6	101.0	102.4	100.2	101.4	S.†	"	"
7,	1	"	–	99.0	100.2	100.0	101.2	101.6	S.†	"	"
8,	1	"	–	99.0	100.8	100.2	99.8	101.8	S.†	"	"
9,	1	"	–	99.2	100.8	100.4	101.0	101.8	S.†	"	"
10,	.	.	–	–	–	–	–	–		–	–
11,	1	P.M.	–	100.0	98.8	99.8	100.0	100.8	S.†	Out in	morning.
12,	1	"	–	100.2	100.8	100.6	101.4	101.4	S.†	"	"
13,	1	"	–	100.2	100.4	100.6	100.8	101.4	S.†	"	"
14,	1.30	"	–	99.8	99.8	100.2	100.8	101.4	S.†	"	"
15,	1	"	–	100.2	100.4	100.4	101.8	101.4	S.†	"	"
16,	1	"	–	100.8	101.8	101.4	102.0	101.8	S.†	"	"
17,	.	.	–	–	–	–	–	–		–	–
18,	1	P.M.	–	97.2	97.8	100.8	100.6	101.2	S.†	Out in	morning.
19,	1	"	–	100.4	100.2	100.8	99.0	100.8	S.†	"	"
20,	1	"	–	101.8	100.0	100.0	99.0	100.6	S.†	"	"
21,	1	"	–	98.8	101.4	101.0	99.0	100.8	S.†	"	"
22,	1	"	–	100.0	102.0	100.2	98.8	100.2	S.†	"	"
23,	1	"	–	100.6	101.4	96.8	99.4	100.4	S.†	"	"
24,	.	.	–	–	–	–	–	–		–	–
25,	1	P.M.	–	100.0	100.4	99.4	99.0	100.4	S.†	Out in	morning.
26,	1	"	–	100.6	100.8	99.4	98.8	100.8	S.†	"	"

† Sputum case.

REPORT OF THE DELEGATES

TO THE

FARMERS' NATIONAL CONGRESS,

AT ST. PAUL, MINN., 1897.

Report of the Delegates to the Farmers' National Congress,*

At St. Paul, Minn., 1897.

To His Excellency Roger Wolcott.

Sir: — We beg to acknowledge our indebtedness for the courtesy of your appointment as delegates from the State of Massachusetts to the Farmers' National Congress, which held its seventeenth annual session at St. Paul, Minn., on Aug. 31 and Sept. 1, 2 and 6, 1897, and submit the following report.

The Congress assembled in the Representatives Chamber of the State Capitol at St. Paul, at 10 o'clock A.M., Aug. 31, 1897, was called to order by the president, Hon. B. F. Clayton of Iowa, and prayer was offered by Right Rev. Bishop John Ireland of St. Paul.

Addresses of welcome were made by the mayor of St. Paul, Hon. Frank B. Doran; by D. R. McGinnis, Esq., vice-president of the State Agricultural Society; and by Hon. D. M. Clough, governor of Minnesota, which received hearty responses from the officers and delegates assembled.

President Clayton delivered his annual address, from which we quote in part as follows: —

"The farmer reads little and is often doubtful that he is better informed from that little, as he learns from it more things to brood over without finding a remedy for his ills. The little glimpse he obtains from what he reads intensifies his prejudices and does not prepare him to cope with his difficulties. He brushes so little against the world, of which he is so important a part, that the world practically ignores his existence.

* This report has been transmitted to the secretary of the State Board of Agriculture by His Excellency the Governor, and, according to custom, is included in the "Agriculture of Massachusetts."

"He is enumerated in the tables of population, but expunged from the statistical lists of the nation's representatives. He is enrolled on the tax list, but cancelled in the catalogue of those who levy taxes. He is registered in the poll book, but disfranchised of the privileges and immunities of a citizen.

"Until the organization of the Farmers' National Congress and its kindred institutions, a few years ago, he was as isolated as Robinson Crusoe upon his island.

"The benefits which these organizations have conferred on agricultural communities cannot be estimated in dollars and cents. They have taught the wisdom of systematic organization for the greatest good of the greatest number. Their special mission is to prepare the seed, plough, plant and foster a harvest of intelligent votes; not to propose imposing theories, but to apply more judicious and effective measures.

"History teaches that a government that will not protect the masses of its people deserves not to become permanent. Those engaged in agricultural pursuits are a majority of all the people; yet we cannot, if we would, close our eyes to the fact that this majority is practically without voice in shaping public affairs.

"A review of the present Congress and the occupation of its members reveals the fact that the farming element is in no way responsible for disastrous legislation, real or apparent. A sketch of the members of Congress discloses the fact that, out of a membership of four hundred and forty-four in the Senate and House of Representatives, the farming class, representing over thirty millions of people, have thirty-five members in the House and but one in the Senate.

"The chairman of the agricultural committee of the Senate records himself an attorney, and the only farmer on that committee is at the tail end. Ten of the eighteen members of that committee are lawyers by profession.

"The great States of Pennsylvania, Ohio, Michigan, Wisconsin and Missouri have each one farmer to represent them, but Illinois, Indiana and Iowa, the heart and centre of agriculture, have no representative in either branch. The only chairmanship held by a farmer is on the committee of

'Ventilation and Acoustics,'—a position he is least fitted for. This should not be; it is not in accordance with the eternal fitness of things.

"I do not know that either of the great political parties is to blame for this condition of things; the fault lies at your door. It is the fault of the farmer, and a sad comment on his lack of energy and patriotism.

"It is the custom of this organization to engross its resolutions in regard to federal legislation, forward them to the speaker of the House and the president of the Senate. They are ordered printed, and are then placed on the desk of every member, and when so placed, Congress has been quite prompt in their consideration and thereby much needed legislation has been secured.

"When we are credited with what rightfully belongs to this organization, it includes fully fifty per cent of the wealth and population of this great nation of ours.

"Eleven years ago Colonel Beverley of Virginia, then president of this Congress, called attention to the fact that the agricultural department of the government was but little in advance of a half-equipped experiment station conducted in the interest of political favoritism; this body took the matter up, and the result has been to make the Commissioner of Agriculture a cabinet position.

"We said to the Congress of the United States, 'We want our experiment stations enlarged and made more effective; we demand the enactment of pure food laws; we want a more complete system of crop reports; a better signal service.' They have all been laid before the federal Congress, and many of them have been favorably considered.

"I desire to emphasize what I have said on former occasions regarding the political attitude of this body. A man that has no political convictions is not fit to represent his district or State in the Farmers' National Congress.

"While we are a non-partisan organization, it is fair to presume that we represent nearly every phase of American politics. A man cannot be a good citizen and stay away from the polls and permit elections to be controlled by disreputable political demagogues. It is the place of every well-wisher of his country at the local caucus of the party to

which he belongs, and to use his influence in behalf of the best men, regardless of professions or occupations."

A resolution making the members of the Agricultural Press League honorary members of the Congress was unanimously adopted, as was a resolution thanking the people of St. Paul and the State of Minnesota for their cordial welcome.

Secretary Stine of the Commercial Club gave a cordial invitation to the delegates to make the club rooms their headquarters during the session.

A committee of three, of whom Mr. Candage of Massachusetts was one, was appointed on the president's address; a committee of five was appointed on credentials, which exhausted the morning hour; and Congress took a recess for dinner, to reassemble at 2 o'clock P.M.

At the afternoon session the committee on credentials reported thirty-one States and two Territories, represented by upwards of three hundred delegates; New England being represented by Mr. Moody of Maine, by Messrs. Avery, Candage and Porter of Massachusetts and by Mr. Stockwell of Rhode Island, — New Hampshire, Vermont and Connecticut having no delegates.

A committee of one delegate from each State and Territory was appointed on resolutions, Messrs. Moody, Candage and Stockwell being the New England members of that committee; a committee of five on finance; a committee of seven on location of the next Congress, of which Mr. Avery of Massachusetts was one; and Mr. Avery was also appointed sergeant-at-arms.

After the completion of routine business, the reading of papers was taken up, and the reading and discussion was opened by Mr. Candage of Massachusetts, by a paper on "The value of river and harbor improvements and shipping to agriculture."

After its reading, an animated and interesting discussion followed; its arguments were duly considered and agreed to, and later were unanimously adopted, under suspension of the rules, in two resolutions embodying the gist of the paper.

Other papers followed: "The best methods of further increasing the usefulness and practical value of agricultural

education," by Hon. W. M. Leggett, dean of the Minnesota School of Agriculture; and at the evening session Mrs. Edwards of Minneapolis spoke on "Intensified farming," in which she compared American farming of large areas with that of the compact methods employed by the Chinese. The papers were able and instructive, and elicited hearty responses from the delegates.

The evening session was wholly given to reading and discussion of papers, at which there was a large attendance of delegates.

WEDNESDAY, SEPT. 1, 1897.

The morning session was taken up with the election of officers of the Congress for the two years ensuing.

President, Ex-Gov. W. D. Hoard of Wisconsin; secretary, John M. Stahl of Chicago; treasurer, N. G. Spalding of New York; first assistant secretary, D. O. Lively of Fort Worth, Tex.; second assistant secretary, George A. Stockwell of Providence, R. I.; and third assistant secretary, Alexander Dunlap of Manistee, Mich.

Vice-presidents were chosen, one from each State; from New England, as follows: Maine, W. H. Moody; New Hampshire, J. W. Lantrom; Vermont, G. J. Spear; Massachusetts, R. G. F. Candage; Rhode Island, George A. Stockwell; and from Connecticut, J. H. Hale.

Senor Romero, Mexican minister at Washington, made a brief address, setting forth the advantages of Mexico as an agricultural country. He said that a pound of coffee raised in Mexico cost ten cents in silver, and it would sell for fifteen or twenty cents in gold; and he predicted great results from the development of agriculture in his country in the near future.

Senor Sateldo of Venezuela also made a pleasant address, in which he congratulated the American farmer upon the approach of better times, higher prices for farm products and increased demands for them from foreign countries.

Resolutions were reported and adopted, as follows: "In favor of a United States commission to investigate and report the feasibility of larger markets with China, Japan and neighboring islands for our bread stuffs;" "Recommending the establishment of government postal savings

banks;" "That the president of the Farmers' National Congress appoint a standing committee of three, to be known as the classification and freight rate committee;" "In favor of reclaiming and improving the Mississippi, its channels and tributaries, for the improvement of its navigation;" "For the establishment of a domestic science department of agriculture at Washington, D. C.;" "Improvement of mail facilities in rural districts to the fullest extent;" "For an act of Congress allowing each State to copyright labels for the protection of its products;" "Restrictive measures against improper immigration;" "In favor of electing United States Senators by the people;" "In favor of teaching the elementary principles of agriculture in the public schools;" "In favor of constructing, owning and operating the Nicaragua Canal by the United States;" "For the extermination of the gypsy moth;" and "In favor of the passage of the free homestead bill now pending before the Congress of the United States."

E. W. Randall, secretary of the Minnesota State Fair, read a paper on "The State fair; causes of success or failure," which was well received and discussed.

At the opening of the afternoon session, Hon. N. G. Spalding of New York read a paper on "Taxation,— municipal, State and national," which was listened to with great interest.

An interesting address was also made, following Mr. Spalding, by F. E. Orr of Pittsburgh, Pa., the president of the Agricultural Press League, on "The benefits of the agricultural press to the farmer, and how they can be increased."

Mrs. Emma C. Sickles of Chicago, president of the Domestic Science Association, gave a short but interesting talk upon the subject "Necessity for protection from adulteration of food, and the fuller facilities in the proper preparation of food."

There was a brief evening session, at which a paper was read on "The beet sugar industry," prepared by A. S. Goetz, manager of the Pecco Valley Sugar Company of New Mexico. The paper was highly interesting, and a brief discussion followed, cut off by the hour of adjournment.

The delegates went from their deliberations to the rooms of the Commercial Club, where they were entertained and given a collation, followed by dancing. Speeches were made, music and recitations were provided, and at a late hour all retired to their homes and hotels, having greatly enjoyed the occasion.

THURSDAY, SEPT. 2, 1897.

The morning session was devoted to reading papers, discussions, resolutions, fixing the location for the annual session of 1898, and other important matters.

J. E. Northrop, delegate from the "National Association of Seed Growers and Nurserymen," read a caustic criticism on what he styled the "Government seed shop."

Resolutions were offered and passed: "In favor of discriminating duties on imports in American bottoms, designed to foster American shipping;" "In favor of liberal appropriations for rivers and harbors;" "A change in the constitution of the Congress, enlarging its membership, so that, in addition to delegates now appointed by the governor of the States, one to be appointed from each agricultural college and experiment station and one from each society organized for fostering agriculture."

It was voted to hold the next annual session of this Congress at Fort Worth, Tex., in December, 1898. F. L. Maxwell of Louisiana was chosen first vice-president, and C. A. Wieting of New York second vice-president.

The committee on finance reported the receipt of five hundred dollars from the citizens of St. Paul, and recommended a levy of one dollar on each delegate for a fund for the publication and distribution of the report of the Congress, which was accepted and adopted.

Prof. W. M. Hays of the Minnesota School of Agriculture read an interesting paper on "The rural schools," teaching the elementary courses in agriculture.

The afternoon was devoted to an inspection of the State Experiment Farm and School of Agriculture of Minnesota.

A short session was held at the school-room of the farm, where Mrs. Julietta Ashby Jordan of Indian Territory read

a paper on "Agriculture as a civilizer among the American Indians."

Mrs. Ada M. Ewing of Iowa read a thoughtful paper on "Industrial activities."

A stir was made in the Congress by the introduction of populistic resolutions by a member of the committee on resolutions, which had been rejected by that committee, and filibustering was resorted to; but by prompt action the Congress put down the attempt, and gave notice that "old political straw could not be rethreshed at its sessions."

A resolution was passed "commending the Secretary of Agriculture in protecting the dairy interests of the country," "for the appointment of a committee to draught a plan for the prevention of the spread of contagious diseases among domestic animals."

At the evening session Mark H. Coad of Fremont, Neb., read an interesting paper on "Horse breeding for profit."

A Mr. Doran, representing the L. A. W., made a strong plea for State aid in constructing wagon roads, by which means farmers would be relieved of the sole responsibility for good roads in the country.

Prof. H. W. Campbell of Sioux City, by the assistance of charts, exemplified the Campbell system of soil culture, applied to raising corn, potatoes and other crops in his State.

The Congress adjourned until Monday, at 9 o'clock A.M., in order that the delegates might accept the complimentary trip to the wheat fields of the Red River valley, North Dakota, tendered by the Great Northern Railway Company.

Trip to the Red River Valley, North Dakota.

Friday, Sept. 3, 1897, the special Great Northern train, consisting of thirteen passenger cars, laden with over five hundred delegates and friends, pulled out of the St. Paul station at 7 o'clock A.M., and started for the Red River valley. The road management had attended to the comfort of its passengers *en route* by providing for them a substantial lunch, to be eaten on the train.

The train passed through agricultural portions of Minnesota to the towns of St. Cloud, Alexandria, Moorhead

City and to Fargo, N. D., where it halted for supper and for the night.

Mayor Johnson of Fargo, with a committee of citizens, had provided carriages, which took the delegates on their arrival for a drive about town, along the Red River Park and to the North Dakota Agricultural College, etc. One of the committee was a former resident of Boston, who had been in Fargo eight years, and owned a wheat farm of 8,000 acres in that vicinity, the different stations of which were connected by telegraph and telephone.

The hotels of the town were overtaxed to accommodate so large a number of visitors, but the citizens opened their houses, and all were comfortably lodged.

An enthusiastic meeting was held at Masonic Hall in the evening, where the mayor and others made addresses of welcome, responded to by members of the Farmers' National Congress.

The weather was exceedingly hot, the thermometer at 97°, with a strong, hot wind blowing from over the prairie.

The Red River valley, and, in fact, the greater part of North Dakota, is a prairie as flat as the sea, and on the night spent at Fargo the sun went down behind the western horizon in a flood of glory, as often seen to do on the ocean.

Fargo is a town of 8,000 inhabitants, well laid out in broad streets, and has good buildings; it was settled less than twenty-five years ago, and lies upon the banks of the Red River of the North, the dividing line between Dakota and Minnesota.

Before it was settled by whites, the State was Indian territory. It is a fertile, wheat-raising State, its crop this year in that cereal amounting to 44,000,000 bushels. The whole population of the State is estimated at 182,000; its area is 70,000 square miles.

The Red River rises in Lake Traverse, one mile from Lake Big Stone, the source of the Minnesota River, the latter emptying its waters into the Mississippi and the Gulf of Mexico, the former running north through Lake Winnipeg and finding entrance into the ocean at Hudson's Bay.

In April the ice and snow of Dakota melt, while the river farther north is frozen, causing an inundation along its banks

thirty miles in width and to the depth of two to five feet. The flood lies upon the land from two to four weeks, when it subsides, and the farmers begin immediately to plough and sow their seed, claiming that the overflow, like that of the Nile, makes the land more fruitful.

The summer in North Dakota is but little over four months, but very hot; the winter, eight months, with blizzards, heavy falls of snow and extremely cold, with the thermometer far below zero. The soil, however, is rich prairie, and raises the best flouring wheat in the world, the average yield being twelve bushels to the acre.

We left Fargo at 7 o'clock Saturday morning, and proceeded north, parallel with the Red River, some eighty miles to Grand Forks, a town of 6,000 inhabitants, and a prettier place than Fargo.

Here the delegates were shown marked attention, and were driven about town at the expense of its citizens. The public buildings, court house, school-houses, hotel, railway station and private residences exhibited taste and thrift.

From Grand Forks our way turned sharply to the west, to Larimore, a town named for the first settler, who owns a farm of 12,000 acres. Mr. Larimore was desirous of having the excursionists visit his farm, then in the midst of wheat harvesting; but other arrangements had been made, and the distance to be covered by the train in the home stretch to St. Paul, 350 miles, would not permit.

Larimore has a fine railway station, hotel, school buildings and residences which would honor many a town two hundred years its senior in age.

From Larimore the route was due south down the Red River valley some 50 miles west of our route north, but parallel with it. It was through the richest wheat lands of that fertile valley, golden with ripening grain, which the farmers were busy harvesting. On either side, as far as the eye could take in, there was one vast expanse of wheat, with reapers and threshers at work all along the route.

At Mayville, some 50 miles west of Fargo, the train halted for the excursionists to take dinner, which had been prepared by the ladies of that town at half a dollar a head, the proceeds to be devoted to the establishment of a hospital in that town.

There the delegates were photographed, and there Mr. Whitney, the general passenger agent of the railroad, who accompanied the delegates, was put into a wagon, to which ropes were attached, and was hauled in triumph through the town to the Grandin Farm and back.

After a stop of two hours the train started southward, passing through extensive wheat fields, at one of which there was a halt, to visit the threshers, reapers and binders at work, and there another photograph of the delegates was taken.

At Wahpeton the delegates stopped for supper at the hotel. Wahpeton is on the banks of the Red River, some sixty miles south of Fargo, and our last stop in North Dakota.

After supper the delegates gathered upon the platform at the station and sang "My country, 'tis of thee," while the engine was taking fuel and water.

The writer turned to a Nebraska man at its finish, and said, "That is a good New England hymn," and after the prairie ride of the past two days he longed for the "rocks and rills, the woods and templed hills" as he never longed for them before.

On leaving Wahpeton the train crossed the Red River to Breckenridge in Minnesota, bidding adieu to North Dakota, the Red River valley, which has aptly been called "the bread-basket of America."

The return from thence to St. Paul was at night, so the excursionists had no opportunity of seeing the country passed through, and the train reached St. Paul depot on Sunday morning, forty-eight hours after starting out upon the 700-mile trip.

On the train a memorial was subscribed to by the delegates, for Mr. Whitney, and resolutions of thanks were passed to the Great Northern Railway Company for the courtesy of the trip, which at regular fares would have amounted to more than $10,000.

Monday morning, September 6, the Farmers' National Congress held a short session in the State Capitol, passed several complimentary resolutions, made the retiring president a life member, finished its business, and adjourned, to meet at Fort Worth, Tex., in December, 1898.

The managers of the Minnesota State Fair presented the delegates with tickets to the fair, the privileges of which a large number availed themselves of to attend, and then left for their homes at evening.

The sessions of the Farmers' Congress at St. Paul were equal to any it has held in ability, papers read, discussions and quality of work accomplished.

The majority of the delegates expressed a desire to hold the Farmers' National Congress in Boston in 1899, provided suitable arrangements could be made for so doing. It is to be hoped that arrangements will be made to carry their desire into effect.

St. Paul is a city of 180,000 people, many of them from New England and the Eastern States, giving to it a home-like atmosphere to the Massachusetts delegates.

Minneapolis, its twin, has 200,000 people, and the same general characteristics as St. Paul. They were first settled in 1849, are located on the banks of the upper Mississippi, and have fine streets, fine public and private buildings, water, sewerage, gas, electricity and all modern improvements. Both cities have fine park systems, fine street railway systems and steam railways connecting the two.

Minneapolis is known the world over as the greatest of all flour-producing cities on the globe. There are many fine bridges across the Mississippi at the two cities, and the signs of push and prosperity among the inhabitants are everywhere noticeable.

Below the centre of St. Paul, upon a bluff 400 feet above the waters of the Mississippi, and commanding a beautiful view in either direction, are seven mounds of the ancient mound builders. Three of them are 75 feet broad at their base and 20 feet in height, having the appearance of a haycock flattened by a heavy rain. The other four are small, mere children, so to speak, by the side of the other giant forms. They are grassed over and guarded with care by the city. Whoever the people were that built them, they were not lacking in artistic taste in selecting that sightly and charming spot for their erection.

The Falls of Minnehaha, near Minneapolis, and the Soldiers' Home, located upon a commanding bluff of the Mississippi,

with Lakes Harriet, Como and other places of interest, should not be overlooked by the visitor to St. Paul and Minneapolis.

A few facts in relation to the State of Minnesota may not be out of place in closing this report.

Minnesota, in the Indian language, signifies "sky-tinted water," or "clear blue water;" and when we consider that within the borders of the State there are more than 10,000 lakes, great and small, whose clear waters were appreciated by the aborigines, we see the appropriateness of the name.

These lakes are said to cover an area of 2,500,000 acres, or 4,000 square miles, not including the area of its great rivers. The largest of these lakes, not including Superior, on its eastern border, are Lake of the Woods, 612 square miles; Red Lake, 342; Mille Lacs, 198; Leech, 194; Rainy, 146; Winnebigoshish, 78; and Vermillion, 63 square miles.

Minnesota has also many rivers, such as the Mississippi, which takes its rise in Lake Itaska, and its tributaries, direct and indirect, are numerous; and there are the Crow Wing, Rum, Crow, St. Croix, Minnesota, Mankato, Elk, etc. The St. Louis and others discharge their waters through the Great Lakes into the Gulf of St. Lawrence; the Red River through Lake Winnipeg into Hudson's Bay; while the Mississippi and its tributaries discharge theirs into the Gulf of Mexico. The water-shed divide of this part of the continent is in Minnesota.

The State has an area of 83,365 square miles, — larger than all New England by a surplus equal to twice the area of Massachusetts, with that of Rhode Island included once. To a New Englander the proportions and area of this great State of the west seem gigantic.

Minnesota east of the Mississippi River was a portion of the original domain of the United States, and has belonged successively to the North-west Territory and to the Territories of Indiana, Illinois, Michigan, Wisconsin and Minnesota. That part west of the Mississippi was included in the Louisiana purchase from France, and has belonged in turn to the District of Louisiana, to the Territory of Louisiana, and to the Territories of Missouri, Michigan, Wisconsin and Minnesota. Part of the south-eastern section was for a time included in the State of Iowa.

In 1849 the Territory of Minnesota was organized, with twice its present area, and with a population of less than 6,000.

In 1853 the State was admitted into the Union with its present limits, but the western portion remained Minnesota Territory until 1861, when it was merged into the new territory of Dakota, now the States of North and South Dakota.

The present population of Minnesota is claimed to be about 2,000,000; in 1890 it was 1,301,826.

The people of the State went thither from the northern States, and those from Europe, from Sweden, Norway, Germany, Denmark, Finland and Lapland, the proportions being in the order here named.

The climate in winter is severe, but of a dry and steady cold, which makes it more endurable than the New England winter, with its east winds and sudden changes.

Minnesota raises large crops of wheat, corn, barley, oats, hops, flaxseed, hay and potatoes, the latter being excellent in quality. Fruits are produced, the apple largely, of fine appearance and flavor; cranberries are also grown, and grapes and small fruits do well.

The raising of cattle, horses, swine, sheep and poultry is a large industry in the State, as are dairy products and maple sugar. The pork-packing and wool-growing industries are large, and are capable of extension.

The commercial advantages of Minnesota are superior to most of the States of the north-west; for through the lakes it is as near the east as is Chicago, while the Mississippi gives direct communication with the Mexican Gulf.

Minnesota, from its commanding position, its vast territory and resources, and the energy and intelligence of its people, is destined to take its place in the front rank of the great and prosperous commonwealths of our country.

The courtesies extended by its people to the delegates to the Farmers' National Congress will ever be held in remembrance.

R. G. F. CANDAGE,
For the Delegates.

BOSTON, NOV. 18, 1897.

FINANCIAL RETURNS

AND

ANALYSES OF PREMIUMS AND GRATUITIES

OF THE

INCORPORATED SOCIETIES,

WITH MEMBERSHIP AND INSTITUTES,

FOR THE YEAR 1897.

RETURNS OF SOCIETIES.

AMESBURY AND SALISBURY AGRICULTURAL AND HORTICULTURAL SOCIETY.

Incorporated 1881, Acts of 1881, chapter 204.

Originally raised by contribution, $1,002.32; now has $8,228.75 invested as a capital stock in real estate, crockery, tables, etc. Total assets, $8,268.96: real estate, $7,-873.29; crockery, tables, etc., $355.46; cash on hand, $40.21. Total liabilities consist of notes to the amount of $1,900. Receipts in 1897, $3,166.54: bounty, $600; new members, $27; donations, $36.15; other sources, $2,503.39. Expenditures in 1897, $2,526.33: premiums and gratuities paid, $897.32; current running expenses, $149.70; interest, $114; other expenses, $1,365.31. The society offered $1,800 in premiums, and awarded and paid $897.32 in premiums and gratuities, which went to 26 cities and towns. Two hundred and fourteen dollars and eighty-five cents went to 10 cities and towns outside the State. Four hundred and fifty-four persons received premiums and 180 gratuities. Under head of farms $33 was awarded and paid; under farm and pet stock $436.75 was awarded and paid; under field and garden crops $5 was awarded and paid; under farm and garden products $129.50 was awarded and paid; under dairy products $3.25 was awarded and paid; under domestic manufactures $88.25 was awarded and paid; under objects strictly agricultural, not specified, $55.54 was awarded and paid; under objects other than agricultural, not specified, $146.03 was awarded and paid. The society reports 252 members, — 223 males and 29 females. Five farmers' institutes were held: at Newbury, January 21, on "Taxation from the farmer's stand-point" and "How to make New England agriculture more profitable;" at Amesbury, February 18, on "The new agriculture, or a system of farming for success" and "Farm machinery;" at Amesbury, March 18, on "Farming with fertilizers;" at Amesbury, April 9, on

"Animal structure *v.* purpose" and "The farm, the home and the grange;" and at Amesbury, December 10, on "The feeding of poultry not all there is to poultry culture."

BARNSTABLE COUNTY AGRICULTURAL SOCIETY.

Incorporated 1844, Acts of 1844, chapter 114.

The society in its first report to the Board in 1853 reported the amount of its permanent fund (par value) to be $1,740; now has $8,300 invested as a capital stock in real estate and bonds. Total assets, $8,623: real estate, $7,500; bonds, $800; cash on hand, $323. Total liabilities consist of mortgages or like liabilities to the amount of $3,575. Receipts in 1897, $3,952.21: bounty, $600; bonds, $10; donations, $353.75; other sources, $2,988.46. Expenditures in 1897, $3,629.03: premiums and gratuities paid, $1,311.85; interest, $189.50; other expenses, $2,127.68. The society offered $1,311.85 in premiums, and awarded and paid $1,311.85 in premiums and gratuities, which went to 9 towns. One hundred and six persons received premiums and 170 gratuities. Under head of farm and pet stock $353.25 was awarded and paid; under field and garden crops $24.25 was awarded and paid; under farm and garden products $143.95 was awarded and paid; under dairy products $5 was awarded and paid; under domestic manufactures $165.40 was awarded and paid; under trotting $600 was paid; under objects other than agricultural, not specified, $20 was awarded and paid. The society reports 542 members,—314 males and 228 females. Four farmers' institutes were held: at Barnstable, February 10, on "The management of agricultural societies;" at Centreville, February 17, on "The growing of small fruits;" at East Sandwich, February 25, on "Poultry" and "Roads;" and at Sandwich, March 18, on "The reflections of a modern hayseed."

BERKSHIRE AGRICULTURAL SOCIETY.

Incorporated 1811, Acts of 1811, chapter 70.

The society in its first report to the Board in 1853 stated the amount of its permanent fund (par value) to be $3,000; now has $12,000 invested as a capital stock in real estate.

Total assets, $12,563.87: real estate, $12,000; crockery, tables, etc., $200; bills due and unpaid, $327; cash on hand, $36.87. Total liabilities, $7,331.36: premiums due and unpaid, $120; outstanding bills, $211.36; mortgages or like liabilities, $7,000. Receipts in 1897, $8,006.98: bounty, $600; new members, $92; other sources, $7,314.98. Expenditures in 1897, $7,970.11: premiums paid, $1,476.50; current running expenses, $4,288.61; interest, $446.52; other expenses, $1,758.48. The society offered $2,141 in premiums and awarded and paid $1,476.50, which went to 30 cities and towns. Forty-five dollars and twenty-five cents went to 2 towns outside the State. Three hundred and eighty-one persons received premiums. Under head of farms $39 was awarded and paid; under farm and pet stock $825 was awarded and paid; under field and garden crops $95 was awarded and paid; under farm and garden products $210.50 was awarded and paid; under dairy products $18 was awarded and paid; under domestic manufactures $214.75 was awarded and paid; under trotting $1,600 was paid; under objects other than agricultural, not specified, $74.25 was awarded and paid. The society reports 1,005 members, — 894 males and 111 females. Three farmers' institutes were held: at Richmond, March 12, on "The restoration of exhausted farms by practical methods;" at Lee, March 30, on "Rural and farm law" and "The new agriculture, or a system of farming for success;" and at New Lenox, December 14, on "How to improve the New England farm."

BLACKSTONE VALLEY AGRICULTURAL SOCIETY.

Incorporated 1884, Acts of 1884, chapter 48.

Originally raised by contribution, $3,000; now has $4,500 invested as a capital stock in real estate, crockery, tables, etc. Total assets, $4,526.80: real estate, $4,400; crockery, tables, etc., $100; cash on hand, $26.80. Total liabilities consist of mortgages or like liabilities to the amount of $1,600. Receipts in 1897, $1,688.86: bounty, $600; new members, $24; other sources, $1,064.86. Expenditures in 1897, $1,661.64: premiums and gratuities paid, $636.44; current running expenses, $945.20; interest, $80. The

society offered $900 in premiums, and awarded and paid $636.44 in premiums and gratuities, which went to 16 cities and towns. One dollar and sixty cents went to 1 city outside the State. One hundred and nineteen persons received premiums and 24 gratuities. Under head of farms $84 was awarded and $79 paid; under farm and pet stock $464.50 was awarded and $444.50 paid; under field and garden crops $29.50 was awarded and $24 paid; under farm and garden products $44.65 was awarded and $41.25 paid; under dairy products $3.50 was awarded and paid; under domestic manufactures $24.90 was awarded and $14.24 paid; under trotting $55 was paid; under objects other than agricultural, not specified, $32.65 was awarded and $29.95 paid. The society reports 536 members,— 275 males and 261 females. Three farmers' institutes were held: at Mendon, March 24, on "The insect enemies of fruit and shade trees" and "Insect pests of the household;" at Uxbridge, April 10, on "The ensilage system;" and at Uxbridge, April 29, on "The usefulness of the Board of Agriculture."

BRISTOL COUNTY AGRICULTURAL SOCIETY.

Incorporated 1823, Acts of 1823, chapter 32.

The society in its first report to the Board in 1853 stated the amount of its permanent fund (par value) to be $3,240; now has $32,000 invested as a capital stock in real estate. Total assets, $33,234.87: real estate, $32,000; crockery, tables, etc., $400; cash on hand, $834.87. Total liabilities, $11,075.80: premiums due and unpaid, $75.80; mortgages or like liabilities, $11,000. Receipts in 1897, $15,557.36: bounty, $600; new members, $75; other sources, $14,882.36. Expenditures in 1897, $16,429.22: premiums and gratuities paid, $5,502.35; current running expenses, $7,112.70; interest, $715; other expenses, $3,099.17. The society offered in premiums $6,924, awarded $5,578.15 in premiums and gratuities and paid $5,502.35, which went to 45 cities and towns. Two hundred and twenty-four dollars and ninety-five cents went to 6 cities and towns outside the State. Seven hundred and ninety-eight persons received premiums

and 12 gratuities. Under head of farms $58 was awarded and paid; under farm and pet stock $1,428.25 was awarded and $1,414.25 paid; under field and garden crops $65 was awarded and paid; under farm and garden products $399 was awarded and paid; under dairy products $48.75 was awarded and paid; under domestic manufactures $317.15 was awarded and $255.35 paid; under trotting $2,770 was paid; under objects other than agricultural, not specified, $492 was awarded and paid. The society reports 871 members, — 675 males and 196 females. Three farmers' institutes were held: at Dighton, February 17, on "Dairy farming," "Cold storage for farm products" and "Spraying of fruit;" at New Bedford, March 19, on "The Massachusetts Agricultural College" and "Feeding plants with chemicals;" and at North Raynham, March 26, on "Fruit culture in New England."

DEERFIELD VALLEY AGRICULTURAL SOCIETY.

Incorporated 1871, Acts of 1871, chapter 208.

Originally raised by contribution, $4,094.01; now has $9,200 invested as a capital stock in real estate. Total assets, $9,619.15: real estate, $9,200; crockery, tables, etc., $250; cash on hand, $169.15. Total liabilities consist of mortgages or like liabilities to the amount of $600. Receipts in 1897, $2,864.19: bounty, $600; new members, $36; donations, $39.55; other sources, $2,188.64. Expenditures in 1897, $1,976.18: premiums paid, $984.95; current running expenses, $798.11; interest, $43.12; other expenses, $150. The society offered $1,275.75 in premiums, awarded $1,024.50 and paid $984.95, which went to 23 cities and towns. Thirty-seven dollars and seventy-five cents went to two towns outside the State. It is estimated that 240 persons received premiums. Under head of farm and pet stock $530.25 was awarded and $498.50 paid; under farm and garden products $67.30 was awarded and $63.70 paid; under dairy products $23 was awarded and paid; under domestic manufactures $97.20 was awarded and $93 paid; under trotting $247.50 was paid; under objects other than agricultural, not specified, $59.25 was awarded and paid.

The society reports 1,105 members, — 860 males and 245 females. Four farmers' institutes were held: at Charlemont, January 4, on "The production of milk, or the management of milch cows;" at East Charlemont, January 20, on "Growing timber as a crop on the waste lands of Massachusetts;" at Ashfield, February 6, on "The work and influence of the Massachusetts Agricultural College" and "Eastern *v.* western farming;" and at Charlemont, March 13, on "Forage crops for feeding during the fall months for cream" and "Milk production."

EASTERN HAMPDEN AGRICULTURAL SOCIETY.

Incorporated 1856, Acts of 1856, chapter 156.

Originally raised by contribution, $3,000; now has $7,000 invested as a capital stock in real estate. Total assets, $7,051.70: real estate, $7,000; bills due and unpaid, $51; cash on hand, $0.70. Total liabilities, $4,197.47: outstanding bills, $1,137.47; mortgages or like liabilities, $3,060. Receipts in 1897, $3,445.73: bounty, $600; new members, $13; donations, $127.77; other sources, $2,704.96. Expenditures in 1897, $3,445.73: premiums and gratuities paid, $1,621.35; other expenses, $1,824.38. The society offered $2,194.25 in premiums, and awarded and paid $1,621.35 in premiums and gratuities, which went to 21 cities and towns. Two hundred and thirty dollars and fifty cents went to 3 cities and towns outside the State. One hundred and eighteen persons received premiums and gratuities. Under head of farms $24 was awarded and paid; under farm and pet stock $522.50 was awarded and paid; under farm and garden products $137.75 was awarded and paid; under dairy products $11 was awarded and paid; under domestic manufactures $51.10 was awarded and paid; under trotting $825 was paid; under objects other than agricultural, not specified, $9 was awarded and paid. The society reports 478 members, — 283 males and 195 females. Three farmers' institutes were held: at Wilbraham, January 21, on "How to feed the dairy cow for milk and cream production;" at Palmer, February 12, on "How to make

New England agriculture more profitable;" and at Warren, March 4, on "The reflections of a modern hayseed" and "Growing and feeding forage crops for profit."

ESSEX AGRICULTURAL SOCIETY.

Incorporated 1818, Acts of 1818, chapter 25.

The society in its first report to the Board in 1853 stated the amount of its permanent fund (par value) to be $9,363.66; now has $30,500 invested as a capital stock in real estate, notes, stocks, crockery, tables, etc. Total assets, $30,500: real estate, $15,300; notes, $1,000; stocks, $14,000; crockery, tables, etc., $200. Total liabilities consist of notes and overdraft to the amount of $9,316.31. Receipts in 1897, $3,630.63: bounty, $600; notes, $55.08; stocks, $828.41; new members, $36; donations, $38; other sources, $2,073.14. Expenditures in 1897, $2,674.06: premiums paid, $1,209; current running expenses, $605.53; interest, $469.42; other expenses, $390.11. The society offered $2,356 in premiums, awarded $1,479.75 * and paid $1,289,* which went to 28 cities and towns. Four hundred and sixty-eight persons received premiums. Under head of farms $54 was awarded and $59 paid; under farm and pet stock $643.50 was awarded and $466 paid; under field and garden crops $104 was awarded and $79 paid; under farm and garden products $411 was awarded and $369.50 paid; under dairy products $5 was awarded and paid; under domestic manufactures $127.25 was awarded and $132.50 paid; under agricultural implements $37 was awarded and $47 paid; under objects strictly agricultural, not specified, $98 was awarded and $67.75 paid. The society reports 1,484 members, — 1,467 males and 17 females. Three farmers' institutes were held: at Haverhill, January 15, on "Market gardening," "Fruits and vegetables in the home garden" and "Fruit culture in New England;" at Newbury, February 9, on "Poultry keeping for the farm and farmers" and "Little leaks *v.* great wastes;" and at Salem, March 12, on "The reflections of a modern hayseed" and "Book farming *v.* moon farming."

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* Amounts paid for 1896; awarded for 1897.

FRANKLIN COUNTY AGRICULTURAL SOCIETY.

Incorporated 1850, Acts of 1850, chapter 104.

The society in its first report to the Board in 1853 reported the amount of its permanent fund (par value) to be $3,768; now has $9,595 invested as a capital stock in real estate, stocks, crockery, tables, etc. Total assets, $9,747.74: real estate, $8,500; stocks, $1,020; crockery, tables, etc., $75; cash on hand, $152.74. Total liabilities $3,423.81: outstanding bills, $323.81; mortgages or like liabilities, $3,100. Receipts in 1897, $7,828.96: bounty, $600; stocks, $40; new members, $15; donations, $22; other sources, $7,151.96. Expenditures in 1897, $7,676.22: premiums and gratuities paid, $1,329.90; current running expenses, $2,380.79; interest, $165.89; other expenses, $3,799.64. The society offered $1,818 in premiums, awarded $1,380.80 in premiums and gratuities and paid $1,329.90, which went to 23 cities and towns. About 340 persons received premiums and 23 gratuities. Under head of farm and pet stock $1,017.75 was awarded and $986.50 paid; under farm and garden products $180.45 was awarded and $169.95 paid; under dairy products $23 was awarded and paid; under domestic manufactures $134.30 was awarded and $126.75 paid; under trotting $619.80 was paid; under objects other than agricultural, not specified, $13 was awarded and paid. Diplomas were awarded for agricultural implements. The society reports about 1,800 members, — about 1,500 males and about 300 females. Three farmers' institutes were held: at Montague, January 29, on "The dairy interests of the Island of Guernsey" and "The demands of the future on the New England farmer;" at Sunderland, February 20, on "Rural and farm law" and "The reflections of a modern hayseed;" and at Shelburne Falls, March 18, on "Growing and feeding forage crops for profit" and "The farm: its products and profits."

HAMPDEN AGRICULTURAL SOCIETY.

Incorporated 1850, Acts of 1850, chapter 104.

This society held no fair in 1897. A membership of 551 is reported, — 435 males and 116 females. Three farmers' institutes were held: at Springfield, March 17, on "Insect enemies of fruit and shade trees" and "Small fruits;" at Holyoke, March 31, on "Tuberculosis in cattle" and "Roads and roadside improvements;" and at Springfield, April 8, on "Management of agricultural fairs."

HAMPSHIRE AGRICULTURAL SOCIETY.

Incorporated 1814, Acts of 1814, chapter 19.

The society in its first report to the Board in 1853 stated the amount of its permanent fund (par value) to be $3,255.26; now has $4,352.43 invested as a capital stock in real estate, crockery, tables, etc. Total assets, $4,352.43: real estate, $4,200; crockery, tables, etc., $152.43. Total liabilities, $1,301.56: outstanding bills, $251.56; mortgages or like liabilities, $1,050. Receipts in 1897, $1,685.73: bounty, $554.60; new members, $32.50; donations, $72.45; other sources, $1,026.18. Expenditures in 1897, $1,755.68: premiums and gratuities paid, $625.70; current running expenses, $590.98; interest, $59; other expenses, $480. The society offered $879 in premiums, and awarded and paid $625.70 in premiums and gratuities, which went to 15 cities and towns. One hundred and twenty persons received premiums and 16 gratuities. Under head of farm and pet stock $341 was awarded and paid; under field and garden crops $25 was awarded and paid; under farm and garden products $118.75 was awarded and paid; under dairy products $5 was awarded and paid; under domestic manufactures $38.60 was awarded and paid; under agricultural implements $2.25 was awarded and paid; under objects strictly agricultural, not specified, $12 was awarded and paid; under trotting $480 was paid; under objects other than agricultural, not specified, $28 was awarded and paid. The society reports 761 members, — 534 males and 227 females. Three farmers' institutes were held: at Montague,

January 29, on "The dairy interests of the Island of Guernsey" and "The demands of the future on the New England farmer;" at Sunderland, February 20, on "Rural and farm law" and "The reflections of a modern hayseed;" and at Hadley, March 6, on "A year's experience with the army worm" and "Hygiene of farm animals and how to prevent disease."

HAMPSHIRE, FRANKLIN AND HAMPDEN AGRICULTURAL SOCIETY.

Incorporated 1818, Acts of 1818, chapter 125.

The society in its first report to the Board in 1853 stated the amount of its permanent fund (par value) to be $8,141.29; now has $2,815.24 invested as a capital stock in personal property. Total assets, $2,890.16: real estate lease, $1,200; bank funds, $643; crockery, tables, etc., $800; bills due and unpaid, $75; cash on hand, $172.16. Total liabilities, $75: premiums due and unpaid, $10; outstanding bills, $65. Receipts in 1897, $3,761.01: bounty, $600; bank funds, $24.96; new members, $90; other sources, $3,046.05. Expenditures in 1897, $3,791.35: premiums and gratuities paid, $842; current running expenses, $2,813.65; other expenses, $135.70. The society offered $1,428.75 in premiums, awarded $971.35 in premiums and gratuities and paid $842, which went to 23 cities and towns. One hundred and seventy-three persons received premiums and 14 gratuities. Under head of farm and pet stock $691.40 was awarded and $602.15 paid; under field and garden crops $26 was awarded and paid; under farm and garden products $133.50 was awarded and $119.25 paid; under dairy products $14 was awarded and $8 paid; under domestic manufactures $58.45 was awarded and $42.85 paid; under agricultural implements $15 was awarded and $8 paid; under objects strictly agricultural, not specified, $10 was awarded and $6.25 paid; under objects other than agricultural, not specified, $46 was awarded and $29.50 paid. The society reports about 1,052 members, — about 836 males and about 216 females. Three farmers' institutes were held: at Northampton, January 6, on "The demands of the future

on the New England farmer;" at Hadley, March 6, on "A year's experience with the army worm" and "Hygiene of farm animals and how to prevent disease;" and at Easthampton, March 19, on "The farmers' opportunity" and "The management of a dairy farm."

HIGHLAND AGRICULTURAL SOCIETY.

Incorporated 1859, Acts of 1859, chapter 145.

Originally raised by contribution, $3,262; now has $3,150 invested as a capital stock in real estate, crockery, tables, etc. Total assets, $3,249.06: real estate, $3,000; crockery, tables, etc., $150; cash on hand, $99.06. Receipts in 1897, $1,643.70: bounty, $600; new members, $31; other sources, $1,012.70. Expenditures in 1897, $1,544.64: premiums and gratuities paid, $656.65; current running expenses, $877.49; interest, $4.50; other expenses, $6. The society offered $788.80 in premiums, and awarded and paid $656.65 in premiums and gratuities, which went to 21 cities and towns. One hundred and forty persons received premiums and 1 a gratuity. Under head of farm and pet stock $401.75 was awarded and paid; under field and garden crops $22.50 was awarded and paid; under farm and garden products $29.30 was awarded and paid; under dairy products $8.50 was awarded and paid; under domestic manufactures $75.45 was awarded and paid; under trotting $80 was paid; under objects other than agricultural, not specified, $39.15 was awarded and paid. The society reports 420 members, — 291 males and 129 females. Three farmers' institutes were held at Middlefield: January 6, on "Feeding the dairy cow and the soil economically;" September 8, on "Rural and farm law;" and October 25, on "Equal taxation."

HILLSIDE AGRICULTURAL SOCIETY.

Incorporated 1883, Acts of 1883, chapter 112.

Originally raised by contribution, $3,113.32; now has $6,000 invested as a capital stock in real estate, bank funds, crockery, tables, etc. Total assets, $6,000: real estate, $4,600; bank funds, $940; crockery, tables, etc., $334.36;

cash on hand, $125.64. Receipts in 1897, $1,923.46: bounty, $600; bank funds, $40; new members, $128; donations, $22.43; other sources, $1,133.03. Expenditures in 1897, $1,397.82: premiums paid, $737.65; current running expenses, $630.33; other expenses, $29.84. The society offered $720 in premiums, and awarded and paid $737.65, which went to 28 towns. Three hundred and thirty-eight persons received premiums. Under head of farm and pet stock $457.50 was awarded and paid; under field and garden crops $42.50 was awarded and paid; under farm and garden products $63.35 was awarded and paid; under dairy products $14.25 was awarded and paid; under domestic manufactures $64.50 was awarded and paid; under agricultural implements $6.50 was awarded and paid; under trotting $21 was paid; under objects other than agricultural, not specified, $50 was awarded and paid. The society reports 640 members, — 608 males and 32 females. Four farmers' institutes were held: at Chesterfield, January 17, on "Common diseases of animals and their treatment;" at Ashfield, February 6, on "The work and influence of the Massachusetts Agricultural College" and "Eastern *v.* Western Farming;" at Cummington, February 25, on "Contagious diseases which now threaten our stock" and "Fruit;" and at Cummington, September 28, on "Market gardening" and "The postal service."

HINGHAM AGRICULTURAL AND HORTICULTURAL SOCIETY.

Incorporated 1867, Acts of 1867, chapter 99.

Originally raised by contribution, $17,406.15; now has $22,000 invested as a capital stock in real estate, crockery, tables, etc. Total assets, $22,002.45: real estate, $20,000; crockery, tables, etc., $2,000; cash on hand, $2.45. Total liabilities consist of notes to the amount of $700. Receipts in 1897, $3,162.15: bounty, $600; new members, $11; donations, $85; other sources, $2,466.15. Expenditures in 1897, $2,651.54: premiums and gratuities paid, $647.50; current running expenses, $764.47; interest, $48.76; other expenses, $1,190.81. The society offered $1,533.35 in pre-

miums, and awarded and paid $647.50 in premiums and gratuities, which went to 12 cities and towns. Two hundred and nine persons received premiums and 353 gratuities. Under farm and garden products $505.85 was awarded and paid; under dairy products $3 was awarded and paid; under domestic manufactures $70.10 was awarded and paid; under objects other than agricultural, not specified, $68.55 was awarded and paid. The society reports 723 members,—507 males and 216 females. Seven farmers' institutes were held at Hingham: January 18, on "The value of stable manures as compared with commercial fertilizers" and "The cause of the present low prices of farm products and how it can be remedied;" February 15, on "Strawberry culture;" March 15, on "A year's experience with the army worm;" April 12, on "Heredity;" May 18, on "Home gardening;" August 9, on "Raspberry culture," "Market gardening," "The hay crop," "The strawberry crop" and "Blight on potatoes;" and on November 8, on "Chrysanthemum culture."

HOOSAC VALLEY AGRICULTURAL SOCIETY.

Incorporated 1860, Acts of 1860, chapter 56.

Originally raised by contribution, $2,006; now has $17,260.49 invested as a capital stock in real estate, crockery, tables, etc. Total assets, $17,930.41: real estate, $16,760.49; crockery, tables, etc., $500; cash on hand, $669.92. Total liabilities, $5,926.40: outstanding bills, $926.40; mortgages or like liabilities, $5,000. Receipts in 1897, $7,902.57: bounty, $600; new members, $40; other sources, $7,262.57. Expenditures in 1897, $7,276.85: premiums paid, $1,507; current running expenses, $3,791.96; interest, $343.80; other expenses, $1,634.09. The society offered $4,319 in premiums, awarded $2,673 and paid $2,433.40, which went to 16 cities and towns. Ninety-eight dollars and seventy-five cents went to 7 cities and towns outside the State. Two hundred and five persons received premiums. Under head of farms $18 was awarded and paid; under farm and pet stock $555 was awarded and paid; under field and garden crops $174 was awarded and paid; under farm and garden products $139.25 was awarded

and paid; under dairy products $26 was awarded and paid; under domestic manufactures $241.75 was awarded and paid; under agricultural implements $6 was awarded and paid; under trotting $1,295 was paid; under objects other than agricultural, not specified, $125 was awarded and paid. The society reports 982 members, — 966 males and 16 females. Three farmers' institutes were held: at Savoy, December 1, on "How to feed the dairy cow" and "The New England farm;" at Williamstown, December 29, on "The business side of farming;" and at Cheshire, December 31, on "How to increase our business and improve our farms."

HOUSATONIC AGRICULTURAL SOCIETY.

Incorporated 1848, Acts of 1848, chapter 101.

The society in its first report to the Board in 1853 stated the amount of its permanent fund (par value) to be $6,335.33; now has $23,085.47 invested as a capital stock in real estate, stocks and bank funds. Total assets, $23,638.44: real estate, $21,000; stocks, $1,000; bank funds, $1,085.47; crockery, tables, etc., $475; bills due and unpaid, $15; cash on hand, $62.97. Total liabilities, $3,369.50: premiums due and unpaid and outstanding bills, $100; mortgages or like liabilities, $3,269.50. Receipts in 1897, $9,937.77: bounty, $600; stocks, $37.50; bank funds, $40.18; new members, $185; other sources, $9,075.09. Expenditures in 1897, $9,797.12: premiums and gratuities paid, $2,076; current running expenses, $3,180.26; interest, $110.45; other expenses, $4,430.91. The society offered $2,589.50 in premiums, awarded $2,101 in premiums and gratuities and paid $2,076, which went to 17 cities and towns. Four hundred and ninety-six persons received premiums and gratuities. Under head of farm and pet stock $1,058.10 was awarded and $1,033.10 paid; under field and garden crops $242 was awarded and paid; under farm and garden products $279 was awarded and paid; under dairy products $42 was awarded and paid; under domestic manufactures $447 was awarded and paid; under trotting, $1,585 was paid; under objects other than agricultural, not specified, and including sports, $856 was

awarded and paid. The society reports 1,744 members, — 1,697 males and 47 females. Three farmers' institutes were held: at Great Barrington, February 4, on "The past and present of the Massachusetts Board of Agriculture;" at Lee, March 30, on "The new agriculture, or a system of farming for success" and "Rural and farm law;" and at Great Barrington, November 30, on "The apple as a money crop for New England: its culture and preparation for market."

MANUFACTURERS' AGRICULTURAL SOCIETY OF NORTH ATTLEBOROUGH.

Incorporated 1896, Acts of 1896, chapter 260.

Originally raised by contribution, $10,000; now has $10,000 invested as a capital stock in real estate, crockery, tables, etc. Total assets, $10,027.01: real estate, $9,500; crockery, tables, etc., $500; cash on hand, $27.01. Receipts in 1897, $5,154.03: bounty, $592.70; other sources, $4,561.33. Expenditures in 1897, $5,154.03: premiums and gratuities paid, $879.65; current running expenses, $3,749.38; other expenses, $525. The society offered $1,190.55 in premiums, and awarded and paid $879.65 in premiums and gratuities, which went to 24 cities and towns. One hundred and thirty-one dollars and forty-five cents went to 6 cities and towns outside the State. Under head of farm and pet stock $554.05 was awarded and paid; under farm and garden products $163.20 was awarded and paid; under dairy products $2 was awarded and paid; under domestic manufactures $83 was awarded and paid; under trotting $1,450 was paid; under objects other than agricultural, not specified, $77.40 was awarded and paid. The society reports 67 male members. Three farmers' institutes were held at Attleborough: February 11, on "Little leaks *v.* great wastes;" November 23, on "Originating and training new varieties of vegetables and notes on the best varieties for cultivation;" and November 9, on "How to improve the New England farm."

MARSHFIELD AGRICULTURAL AND HORTICULTURAL SOCIETY.

Incorporated 1867, Acts of 1867, chapter 116.

Originally raised by contribution, $3,755.43; now has $27,980.08 invested as a capital stock in real estate, crockery, tables, etc. Total assets, $27,980.08: real estate, $26,472.78; crockery, tables, etc., $1,507.30. Total liabilities, $5,336.45: premiums due and unpaid, $66.45; mortgages or like liabilities, $5,270. Receipts in 1897, $2,847.02: bounty, $600; new members, $35; other sources, $2,212.02. Expenditures in 1897, $3,192.68: premiums and gratuities paid, $1,014.80; current running expenses, $1,251.88; interest, $926. The society offered $1,486 in premiums, awarded $1,051.65 in premiums and gratuities and paid $971.95, which went to 27 cities and towns. Ninety-two persons received premiums and 275 gratuities. Under head of farm and pet stock $179 was awarded and $158.50 paid; under farm and garden products $137.75 was awarded and $112 paid; under domestic manufactures $114.58 was awarded and paid; under trotting $586.87 was paid; under objects other than agricultural, not specified, $33.45 was awarded and $31.90 paid. The society reports 860 members, — 553 males and 307 females. Four farmers' institutes were held at Marshfield: March 2, on "Dairying" and "The possibility of having a milk car run from Marshfield;" March 23, on "Small fruits" and "Market gardening;" August 7, a practical illustration of clearing up land; and August 25, on "Poultry culture."

MARTHA'S VINEYARD AGRICULTURAL SOCIETY.

Incorporated 1859, Acts of 1859, chapter 33.

Originally raised by contribution, $4,552.17; now has $4,332.63 invested as a capital stock in real estate, notes, bank funds, crockery, tables, etc. Total assets, $4,655.85: real estate, $2,750; notes, $400; bank funds, $982.63; crockery, tables, etc., $200; bills due and unpaid, $21; cash on hand, $302.22. Total liabilities, $68: premiums

due and unpaid, \$43; outstanding bills (estimated), \$25. Receipts in 1897, \$1,261.31: bounty, \$600; notes, \$29; bank funds, \$35.50; new members, \$14; other sources, \$582.81. Expenditures in 1897, \$1,088.20: premiums and gratuities paid, \$629.08; current running expenses, \$284.12; other expenses, \$175. The society offered \$819.50 in premiums, awarded \$672.08 and paid \$629.08 in premiums and gratuities, which went to 7 towns. Forty-two persons received premiums and 127 gratuities. Under head of farms \$5 was awarded and paid; under farm and pet stock \$196.50 was awarded and paid; under field and garden crops \$32 was awarded and paid; under farm and garden products \$134.31 was awarded and paid; under dairy products \$14.75 was awarded and paid; under domestic manufactures \$132.17 was awarded and paid; under trotting \$85.75 was paid; under objects other than agricultural, not specified, \$62.74 was awarded and paid. The society reports 201 members,— 111 males and 90 females. Three farmers' institutes were held at West Tisbury: September 23, on "Beautiful homes;" November 24, on "Shelter for stock;" and April 16, on "Is it profitable to raise grain on the Island?"

MASSACHUSETTS HORTICULTURAL SOCIETY.

Incorporated 1829, Acts of 1829, chapter 22.

The first investment was from surplus, Jan. 16, 1835, and amounted to \$525. The society now has \$247,000 invested as a capital stock in real estate, furniture, library, etc. Total assets, \$353,547.66: real estate, \$250,000; loan, \$22,500; bonds, \$26,852.50; crockery, tables, etc., \$44,888.48; bills due and unpaid, \$2,641.79; cash on hand, \$6,664.89. Total liabilities, \$27,100: premiums due and unpaid, \$8,100; notes payable, \$18,000; mortgages or like liabilities, \$1,000. Receipts in 1897, \$44,171.57: bounty, \$600; bonds, \$1,075; bank funds, \$44.58; new members and assessments, \$1,132; donations, \$32; other sources, \$41,287.99. Expenditures in 1897, \$44,107.29: premiums and gratuities paid, \$7,623.72; current running expenses, \$17,737.73; interest, \$928.50; other expenses, \$17,817.34.

The society offered $8,050 in premiums, awarded $7,700.72* in premiums and gratuities, and paid $7,623.72,* which went to 69 cities and towns. Two hundred and twenty-seven dollars went to 12 cities and towns outside the State. One hundred and eighty-two † persons received premiums and 110 † gratuities. Under head of farms $540 was awarded and $495 paid; under farm and garden products $7,242.25 was awarded and $7,199.47 paid. The society reports 761 members, — 707 males and 54 females. Ten farmers' institutes were held in Horticultural Hall, Boston: January 9, on "Tropical horticulture, with practical illustrations of the principal economic plants of hot climates;" January 16, on "Structure and classification of mushrooms;" January 23, on "The chrysanthemum: its past, present and future;" January 30, on "Plant beauty;" February 13, on "Sweet peas;" February 20, on "Market gardening;" February 27, on "Good food from the garden;" March 13, on "Horticulture in Canada;" March 20, on "Soils and potting;" March 27, on "The spread of plant diseases: a consideration of some of the ways in which parasitic organisms are disseminated."

MASSACHUSETTS SOCIETY FOR PROMOTING AGRICULTURE.

Incorporated 1792, Acts of 1792, chapter 33.

This society made no returns to the Board of Agriculture for the year 1897.

MIDDLESEX NORTH AGRICULTURAL SOCIETY.

Incorporated 1855, Acts of 1855, chapter 315.

Originally raised by contribution, $3,000; now has $35,000 invested as a capital stock in real estate. Total assets, $37,790.20: real estate, $35,000; bank funds, $1,000; crockery, tables, etc., $370; bills due and unpaid, $1,050; cash on hand, $370.20. Total liabilities, $9,180: premiums due and unpaid, $100; outstanding bills, $80; mortgages or

* Offered and awarded in 1896; paid in 1897.
† Not including school gardeners.

like liabilities, $9,000. Receipts in 1897, $3,762: bounty, $600; bank funds, $50; new members, $14; other sources, $3,098. Expenditures in 1897, $4,834.56: premiums and gratuities paid, $681; current running expenses, $2,066; interest, $487.50; other expenses, $1,600.06. The society offered $1,192.75 in premiums, awarded $781 in premiums and gratuities and paid $681 which went to 11 cities and towns. Under head of farm and pet stock $367.50 was awarded; under field and garden crops $6.50 was awarded; under farm and garden products $266.25 was awarded; under dairy products $5 was awarded; under domestic manufactures $109.25 was awarded; under trotting $650 was paid. Two hundred and sixty-one persons received premiums and 125 gratuities. The society reports 1,465 members, — 1,063 males and 402 females. Three farmers' institutes were held: at North Tewksbury, January 6, on "The reflections of a modern hayseed;" at Billerica Centre, February 3, on "Roads and roadside improvements" and "The history of organized agriculture in the United States;" and at Wilmington Centre, March 3, on "The demands of the future on the New England farmer."

MIDDLESEX SOUTH AGRICULTURAL SOCIETY.

Incorporated 1854, Acts of 1854, chapter 84.

Originally raised by contribution, $3,000; now has $13,000 invested as a capital stock in real estate. Total assets, $13,500.72: real estate, $13,000; crockery, tables, etc., $200; bills due and unpaid, $250; cash on hand, $50.72. Total liabilities consist of mortgages or like liabilities to the amount of $8,050. Receipts in 1897, $3,346.59: bounty, $600; new members, $48; donations, $78.85; other sources, $2,619.74. Expenditures in 1897, $3,295.47: premiums and gratuities paid, $648.15; current running expenses, $1,773.48; interest, $422.43; other expenses, $451.41. The society offered $1,251.45 in premiums, and awarded and paid $648.15 in premiums and gratuities, which went to 8 cities and towns. Eighty-seven persons received premiums and 33 gratuities. Under head of farms $41 was awarded and paid; under farm and pet stock $333.50 was awarded and

paid; under field and garden crops $46 was awarded and paid; under farm and garden products $160.60 was awarded and paid, under dairy products $6 was awarded and paid; under domestic manufactures $47.05 was awarded and paid; under trotting $765 was paid; under objects not strictly agricultural, not specified, $15 was awarded and paid. The society reports 555 members, — 370 males and 185 females. Three farmers' institutes were held: at Hopkinton, March 10, on "A year's experience with the army worm;" at Hudson, March 17, on "How to make New England agriculture more profitable;" and at Framingham, December 28, on "Farming forward."

NANTUCKET AGRICULTURAL SOCIETY.

Incorporated 1856, Acts of 1856, chapter 25.

Originally raised by contribution, $3,500; now has $3,200 invested as a capital stock in real estate. Total assets, $3,829.32: real estate, $3,200; bills due and unpaid, $629.32. Total liabilities consist of outstanding bills to the amount of $629.32. Receipts in 1897, $1,238.79: bounty, $597.38; new members, $11; other sources, $630.41. Expenditures in 1897, $1,857.11: premiums and gratuities paid, $569.75; current running expenses, $714.42; other expenses, $572.94. The society offered $1,302 in premiums, and awarded and paid $569.75 in premiums and gratuities, which went to 1 town. One hundred and ninety-three persons received premiums and 154 gratuities. Under head of farms $12 was awarded and paid; under farm and pet stock $289 was awarded and paid; under field and garden crops $20 was awarded and paid; under farm and garden products $54 was awarded and paid; under dairy products $3 was awarded and paid; under domestic manufactures $71.50 was awarded and paid; under trotting $75 was paid; under objects other than agricultural, not specified, $45.25 was awarded and paid. The society reports 521 members, — 215 males and 306 females. Three farmers' institutes were held at Nantucket: October 25, on general farm topics; November 1, on "Poultry farming;" and December 27, on "Profits in dairy farming."

OXFORD AGRICULTURAL SOCIETY.

Incorporated 1888, Acts of 1888, chapter 93.

Originally raised by contribution, $4,400; now has $8,211.95 invested as a capital stock in real estate, cash, crockery, tables, etc. Total assets, $8,211.95: real estate, $7,500; crockery, tables, etc., $200; cash on hand, $511.95. Receipts in 1897, $2,855.80: bounty, $600; new members, $23; donations, $14; other sources, $2,218.80. Expenditures in 1897, $2,343.85: premiums paid, $1,221.34; current running expenses, $375; other expenses, $747.51. The society offered $1,800 in premiums, awarded $1,259.75 and paid $1,221.34, which went to 17 cities and towns. One dollar and forty-five cents went to 1 city and 1 town outside the State. One hundred and twenty-eight persons received premiums. Under head of farms $37 50 was awarded and paid; under farm and pet stock $544.50 was awarded and $519.60 paid; under field and garden crops $45 was awarded and $43.12 paid; under farm and garden products $25 was awarded and $24.69 paid; under dairy products $8 was awarded and $7.24 paid; under domestic manufactures $39.75 was awarded and $34.56 paid; under agricultural implements $1 was awarded and $0.75 paid; under trotting $525 was paid; under objects other than agricultural, not specified, $34 was awarded and $28.88 paid. The society reports 641 members, — 346 males and 295 females. Three farmers' institutes were held: at Oxford, March 20, on "The past and future of the Board of Agriculture" and "The school and the State;" at Sutton, April 6, on "The farm, the grange and the home;" and at Oxford, September 21, on "Accumulated wealth and taxation."

PLYMOUTH COUNTY AGRICULTURAL SOCIETY.

Incorporated as the Agricultural Society in the County of Plymouth 1819, Acts of 1819, chapter 2; name changed to Plymouth County Agricultural Society in 1870, Acts of 1870, chapter 251.

The society in its first report to the Board, in 1853, stated the amount of its permanent fund (par value) to be $9,550; now has $35,200 invested as a capital stock in real estate,

crockery, tables, etc. Total assets, $35,666.27: real estate, $35,000; crockery, tables, etc., $200; bills due and unpaid, $75; cash on hand, $391.27. Total liabilities, $7,160.40: premiums due and unpaid, $1,160.40; mortgages or like liabilities, $6,000. Receipts in 1897, $11,169.53: bounty, $600; donations, $38.55; other sources, $10,530.98. Expenditures in 1897, $10,778.26: premiums and gratuities paid, $1,462.50; current running expenses, $2,727.13; interest, $582.94; other expenses, $6,005.69. The society offered $3,503.50 in premiums, awarded $2,622.90 in premiums and gratuities and paid $1,462.50. Premiums and gratuities were awarded to parties residing in 37 cities and towns. Three hundred and fifty-six persons received premiums and 17 gratuities. Under head of farms $32 was awarded; under farm and pet stock $661.75 was awarded; under field and garden crops $22 was awarded; under farm and garden products $158 was awarded; under dairy products $17 was awarded; under domestic manufactures $166.65 was awarded; under objects strictly agricultural, not specified, $45 was awarded; under trotting $1,462.50 was paid; under objects other than agricultural, not specified, $58 was awarded. The society reports 1,521 members, — 880 males and 641 females. Three farmers' institutes were held: at Middleborough, February 12, on "Barnyard manure and commercial fertilizers: what they are, and how to use them;" at West Bridgewater, April 2, on "Economic summer and winter feeds for milch cows," "The usefulness of the Massachusetts State Board of Agriculture" and "The war against the gypsy moth;" and at Bridgewater, December 21, on "Obstacles to successful farming and how to overcome them."

SPENCER FARMERS' AND MECHANICS' ASSOCIATION.

Incorporated 1888, Acts of 1888, chapter 87.

Originally raised by contribution, $4,034.08; now has $8,950 invested as a capital stock in real estate, crockery, tables, etc. Total assets, $9,013.62: real estate, $8,000; crockery, tables, etc., $950; cash on hand, $63.62. Total liabilities consist of mortgages or like liabilities to the

amount of $700. Receipts in 1897, $2,852.45: bounty, $600; bank funds, $15; new members, $18; donations, $335.86; other sources, $1,883.59. Expenditures in 1897, $3,743.31: premiums and gratuities paid, $1,717.23; current running expenses, $1,047.89; other expenses, $978.19. The society offered $2,500 in premiums, awarded $1,950 in premiums and gratuities and paid $1,717.23, which went to 22 cities and towns. Sixty-five dollars went to 2 towns outside the State. One hundred and sixty-five persons received premiums and 22 gratuities. Under head of farms $43 was awarded and paid; under farm and pet stock $795.05 was awarded and paid; under field and garden crops and farm and garden products $89.75 was awarded and paid; under dairy products $11 was awarded and paid; under domestic manufactures $56 was awarded and paid; under trotting $770 was paid; under objects other than agricultural, not specified, $20 was awarded and paid. The society reports 958 members, — 530 males and 428 females. Three farmers' institutes were held at Spencer: January 20, on "The introduction of agriculture into our common schools" and "The reflections of a modern hayseed;" January 21, on "The farmer's economic need of bees;" and January 22, on "Common plant diseases."

UNION AGRICULTURAL AND HORTICULTURAL SOCIETY.

Incorporated 1867, Acts of 1867, chapter 110.

Originally raised by contribution, $4,447.23; now has $9,000 invested as a capital stock in real estate, crockery, tables, etc. Total assets, $9,099.65: real estate, $8,000; crockery, tables, etc., $1,000; cash on hand, $99.65. Total liabilities, $1,673.20: premiums due and unpaid, $23.20; mortgages or like liabilities, $1,650. Receipts in 1897, $3,161.92: bounty, $600; new members, $73; other sources, $2,488.92. Expenditures in 1897, $3,062.27: premiums and gratuities paid, $1,152; current running expenses, $832.05; interest, $92.87; other expenses, $985.35. The society offered $1,848.55 in premiums, awarded $1,175.20 in premiums and gratuities and paid $1,152, which went

to 19 cities and towns. Five dollars and twenty-five cents went to one town outside the State. One hundred and ninety-eight persons received premiums and 92 gratuities. Under head of farm and pet stock $480.25 was awarded and $458.13 paid; under field and garden crops $33.50 was awarded and paid; under farm and garden products $41.25 was awarded and $40 paid; under dairy products $5.75 was awarded and paid; under domestic manufactures $121.90 was awarded and $110.63 paid; under agricultural implements $10.25 was awarded and $8 paid; under objects strictly agricultural, not specified, $90 was awarded and paid; under trotting $385 was paid; under objects other than agricultural, not specified, $24.95 was awarded and $21.49 paid. The society reports 1,308 members, — 605 males and 703 females. Three farmers' institutes were held at Blandford: January 26, on "A grange, what, why and how;" February 19, on "The war against the gypsy moth" and "The work and influence of the Massachusetts Agricultural College;" and December 15, on "Poultry; its breeding and management."

WEYMOUTH AGRICULTURAL AND INDUSTRIAL SOCIETY.

Incorporated 1891, Acts of 1891, chapter 77.

Amount originally raised by contribution had increased in 1891 to $10,270; the society now has $11,270 invested as a capital stock in real estate, crockery, tables, etc. Total assets, $11,314.68: real estate, $11,000; crockery, tables, etc., $270; bills due and unpaid, $39; cash on hand, $5.68. Total liabilities consist of mortgages or like liabilities to the amount of $2,850. Receipts in 1897, $6,358.56: bounty, $600; new members, $10; donations, $24.50; other sources, $5,724.06. Expenditures in 1897, $6,316.18: premiums and gratuities paid (including trotting), $1,617.65; current running expenses, $150; interest, $135; other expenses, $4,413.53. The society offered $937 in premiums, awarded $737.15 and paid $712.65, which went to 21 cities and towns. One dollar and ten cents went to parties outside the State. Under head of farm and pet stock $366.50 was awarded and $362.50 paid; under farm and garden products $171.60 was

awarded and $158.65 paid; under dairy products $4.50 was awarded and paid; under domestic manufactures $149.20 was awarded and $143.90 paid; under trotting $905 was paid; under objects other than agricultural, not specified, $45.35 was awarded and $43.10 paid. The society reports 490 members, — 484 males and 6 females. Three farmers' institutes were held: at North Weymouth, March 12, on "The composition of milk;" at South Weymouth, March 26, on "How to make good roads, with or without State aid;" and at East Weymouth, April 16, on "Poultry and egg farming."

WORCESTER AGRICULTURAL SOCIETY.

Incorporated 1818, Acts of 1818, chapter 168.

The society in its first report to the Board in 1853 stated that the amount of its permanent fund (par value) was $7,730; now has $150,000 invested as a capital stock in real estate. Total assets, $150,805.05: real estate, $150,000; bank funds, $138.22; crockery, tables, etc., $600; bills due and unpaid, $66.83. Total liabilities, $63,310.50: premiums due and unpaid, $84; outstanding bills, $226.50; mortgages or like liabilities, $63,000. Receipts in 1897, $32,323.60: bounty, $600; bank funds, $8.85; new members, $185; donations, $323; other sources, $31,206.75. Expenditures in 1897, $32,185.38: premiums paid, $8,647.25; current running expenses, $8,924.85; interest, $2,443.24; other expenses, $12,170.04. The society offered $11,328.50 in premiums, and awarded and paid $8,647.25, which went to 84 cities and towns. Eight hundred and thirty-four dollars and twenty-five cents went to 22 cities and towns outside the State. Three hundred and thirty-two persons received premiums. Under head of farm and pet stock $3,359 was awarded and paid; under farm and garden products $984 was awarded and paid; under dairy products $152 was awarded and paid; under domestic manufactures $157.75 was awarded and paid; under objects strictly agricultural, not specified, $155 was awarded and paid; under trotting, $3,725 was paid; under objects other than agricultural, not specified, $114.50 was awarded and paid. The society reports 1,793 members, — 1,631 males and 162 females. Three farmers' institutes were held: at Westborough, January 12,

on "How to make farming pay" and "The cost of a quart of milk;" at Worcester, February 18, on "A year's experience with the army worm" and "The family vegetable garden;" and at Holden, March 5, on "How to feed the dairy cow for milk and cream production."

WORCESTER EAST AGRICULTURAL SOCIETY.

Incorporated 1890, Acts of 1890, chapter 41.

Originally raised by contribution, $1,015; now has $5,-246.17 invested as capital stock in real estate, cash, fixtures, crockery, tables, etc. Total assets, $5,246.17: real estate, $4,162.40; crockery, tables, etc., $858.77; cash on hand, $225. Receipts in 1897, $4,212.56: bounty, $600; bank funds, $11.26; new members, $57; donations, $127; other sources, $3,417.30. Expenditures in 1897, $3,920.68: premiums paid, $1,161.75; current running expenses, $2,575.-59; other expenses, $183.34. The society offered about $1,600 in premiums, awarded $1,161.75 and paid $1,142.25, which went to 22 cities and towns. Three dollars and seventy-five cents went to one city outside the State. Under head of farms $19 was awarded and paid; under farm and pet stock $562.25 was awarded and paid; under farm and garden products $200.75 was awarded and paid; under dairy products $34 was awarded and paid; under domestic manufactures $84 was awarded and paid; under trotting $400 was paid; under objects other than agricultural, not specified, $49 was awarded and paid. The society reports 688 members,—457 males and 231 females. Three farmers' institutes were held: at Clinton, January 22, on "The war against the gypsy moth;" at Lancaster, February 3, on "Eastern *v.* Western farming;" and at Berlin, February 27, on "The raising of small fruits."

WORCESTER NORTH AGRICULTURAL SOCIETY.

Incorporated as the Fitchburg Agricultural Society, 1852, Acts of 1852, chapter 79; name changed to Worcester North Agricultural Society, 1853, Acts of 1853, chapter 359.

Originally raised by contribution, $2,128. Total assets, $1,105.90: notes, $115; crockery, tables, etc., $400; bills

due and unpaid, $75; cash on hand, $515.90. Total liabilities consist of premiums due and unpaid to the amount of $1,156.12. Receipts in 1897, $744.30: bounty, $600; donations, $124.30; other sources, $20. Expenditures in 1897, $501.55: premiums and gratuities paid, $163.42; current running expenses, $151.29; interest, $186.84. The society awarded $215.15 in premiums and gratuities and paid $163.42, which went to 6 cities and towns. Fifty-seven persons received premiums and 75 gratuities. Under farm and garden products $148.50 was awarded and $104.80 paid; under dairy products $2 was awarded and paid; under domestic manufactures $40.15 was awarded and $26.02 paid; under objects other than agricultural, not specified, $34.50 was awarded and $30.60 paid. The society reports 722 members, — 662 males and 60 females. Six farmers' institutes were held: at Leominster, January 13, on "Cleanliness in the dairy" and "The work of the Cattle Commission;" at Ashburnham, February 3, on "Poultry for profit;" at Townsend, February 12, on "Little leaks *v.* great wastes" and "Animal structure the foundation of purpose;" at Ashby, February 22, on "Public schools;" at Lunenburg, March 16, on "Fruit;" and at Westminster, March 17, on "Business principles applied to farming" and "Guernsey cattle."

WORCESTER NORTH-WEST AGRICULTURAL AND MECHANICAL SOCIETY.

Incorporated 1867, Acts of 1867, chapter 117.

Originally raised by contribution, $3,400; now has $12,703.04 invested as a capital stock in real estate, crockery, tables, etc. Total assets, $12,703.04: real estate, $12,000; crockery, tables, etc., $600; cash on hand, $103.04. Total liabilities consist of mortgages or like liabilities to the amount of $2,800. Receipts in 1897, $7,868.39: bounty, $600; new members, $115; other sources, $7,153.39. Expenditures in 1897, $7,878.61: premiums paid, $2,845.96; current running expenses, $3,487.34; interest, $145.31; other expenses, $1,400. The society offered $3,416 in premiums, awarded $2,901.35 and paid $2,845.96, which went to 41 cities and towns. Six hundred and sixty-six

dollars and seventy-five cents went to 9 cities and towns outside the State. One hundred and eighty-eight persons received premiums. Under head of farms $19 was awarded and paid; under farm and pet stock $849.25 was awarded and $832.08 paid; under farm and garden products $197.90 was awarded and $189.75 paid; under dairy products $21 was awarded and paid; under domestic manufactures $51.20 was awarded and $31.80 paid; under agricultural implements $12 was awarded and $6 paid; under trotting $1,430 was paid; under objects other than agricultural, not specified, $321 was awarded and $316.33 paid. The society reports 1,032 members, — 663 males and 369 females. Three farmers' institutes were held: at North Orange, January 8, on "Economical feed for the dairy cow" and "How to improve the New England farm;" at Royalston, January 20, on "Obstacles to successful farming and how to overcome them" and "How to make New England agriculture more profitable;" and at Gardner, April 6, on "The farm, the home and the grange" and "Little leaks *v.* great wastes."

WORCESTER SOUTH AGRICULTURAL SOCIETY.

Incorporated 1855, Acts of 1855, chapter 278.

Originally raised by contribution, $3,127.40; now has $8,500 invested as a capital stock in real estate, crockery, tables, etc. Total assets, $10,938.78: real estate, $10,400; crockery, tables, etc., $500; cash on hand, $38.78. Total liabilities, $770.75: premiums due and unpaid, $19.75; outstanding bills, $51; mortgages or like liabilities, $700. Receipts in 1897, $4,243.91: bounty, $600; new members, $71; other sources, $3,572.91. Expenditures in 1897, $4,527.02: premiums and gratuities paid, $2,074; current running expenses, $1,791.24; interest, $25; other expenses, $636.78. The society offered $2,423 in premiums, awarded $2,074 and paid $2,054.25, which went to 32 cities and towns. One hundred and thirty-six dollars went to 4 cities and towns outside the State. One hundred and ten persons received premiums and 72 gratuities. Under head of farms $47 was awarded and paid; under farm and pet stock $899 was awarded and paid; under farm and garden products

$146.45 was awarded and $138 paid; under dairy products $28 was awarded and paid; under domestic manufactures $88.25 was awarded and $79.25 paid; under agricultural implements $8.50 was awarded and paid; under trotting $830 was paid; under objects other than agricultural, not specified, $26.80 was awarded. The society reports 1,637 members, — 795 males and 842 females. Three farmers' institutes were held: at Sturbridge, January 13, on "How to feed the dairy cow for milk and cream production;" at West Brookfield, February 20, on "How to feed the dairy cow for milk and cream production" and "Economic summer and winter feeds for dairy cows;" and at Podunk, March 17, on "The silo and its uses."

WORCESTER COUNTY WEST AGRICULTURAL SOCIETY.

Incorporated 1851, Acts of 1851, chapter 278.

Originally raised by contribution, $3,175; now has $13,600 invested as a capital stock in real estate, crockery, tables, etc. Total assets, $13,715.27: real estate, $12,600; crockery, tables, etc., $1,000; cash on hand, $115.27. Total liabilities consist of a note for $1,000. Receipts in 1897, $3,452.38: bounty, $600; new members, $25; donations, $25.45; other sources, $2,801.93. Expenditures in 1897, $3,345.98: premiums and gratuities paid, $1,515.78; current running expenses, $1,451.20; interest, $79; other expenses, $300. The society offered $1,875.75 in premiums, awarded $1,541.23 in premiums and gratuities and paid $1,515.78, which went to 28 cities and towns. One hundred and nine dollars and twenty-five cents went to three cities and towns outside the State. One hundred and forty-six persons received premiums and 23 gratuities. Under head of farms $32 was awarded and paid; under farm and pet stock $601.08 was awarded and $581.83 paid; under field and garden crops $6 was awarded and paid; under farm and garden products $161.20 was awarded and $159.82 paid; under dairy products $11 was awarded and $10.50 paid; under domestic manufactures $49.60 was awarded and $48.35 paid; under trotting $670 was paid; under objects

not strictly agricultural, not specified, $135.35 was awarded and $132.28 paid. The society reports 512 members, — 456 males and 56 females. Three farmers' institutes were held: at Barre, January 23, on "Massachusetts weeds and grasses;" at Hardwick, February 12, on "The reflections of a modern hayseed;" and at Oakham, February 19, on "The new agriculture, or a system of farming for success."

Summary.

	1895.	1896.	1897.
Number of societies,	*35	†36	†36
Amount held invested or well secured as a capital stock.	$763,303 42	$801,791 30	$803,181 25
Assets of societies,	861,719 36	902,393 40	923,350 26
Liabilities of societies,	189,821 46	156,161 90	186,176 95
Receipts,	188,403 88	204,241 16	221,182 56
Expenditures,	179,094 89	192,603 32	218,335 95
Bounty received from the State,	20,606 20	20,084 12	20,344 68
Current running expenses,	77,786 73	79,174 07	85,284 08
Amount of premiums offered,	85,838 53	87,494 75	79,503 80
Amount of premiums and gratuities awarded,	66,912 26	68,055 33	59,408 24
Amount of premiums and gratuities paid,	65,209 35	65,839 68	57,606 49
Amount awarded under head of farms,	1,391 00	1,127 83	1,137 50
Amount awarded under head of farm and pet stock.	22,158 47	21,167 61	20,764 68
Amount awarded under head of field and garden crops.	1,305 10	995 50	1,066 75
Amount awarded under head of farm and garden products.	13,483 29	13,107 22	13,475 86
Amount awarded under head of dairy products,	687 21	668 50	578 25
Amount awarded under head of domestic manufactures.	3,692 53	3,986 86	3,778 15
Amount awarded under head of miscellaneous,	3,138 52	4,722 50	3,710 21
Amount paid under head of trotting,	25,247 35	31,263 90	24,893 42
Number of persons receiving premiums,	7,247	7,666	7,242
Number of persons receiving gratuities,	2,872	1,842	1,918
Total male membership of the societies,	23,099	22,897	22,960
Total female membership of the societies,	7,017	7,503	7,718
Total membership of the societies,	30,116	30,400	30,678
Number of farmers' institutes held,	118	128	125

* One held no fair. † Two held no fair.

DIRECTORY

OF THE

Agricultural and Similar Organizations in the State.

FEBRUARY, 1898.

State Board of Agriculture, 1898.

Members ex Officio.

His Excellency ROGER WOLCOTT.
His Honor W. M. CRANE.
Hon. WM. M. OLIN, *Secretary of the Commonwealth.*
H. H. GOODELL, M.A., LL.D., *President Massachusetts Agricultural College.*
C. A. GOESSMANN, Ph.D., LL.D., *Chemist of the Board.*
WM. R. SESSIONS, *Secretary of the Board.*

Members appointed by the Governor and Council.

	Term Expires
JAMES S. GRINNELL of Greenfield,	1899
SPRAGUE S. STETSON of Lakeville,	1900
DWIGHT A. HORTON of Northampton,	1901

Members chosen by the Incorporated Societies.

Amesbury and Salisbury (Agr'l and Hort'l),	F. W. SARGENT of Amesbury,	1900
Barnstable County,	JOHN BURSLEY of West Barnstable,	1901
Berkshire,	WESLEY B. BARTON of Dalton,	1900
Blackstone Valley,	SAMUEL B. TAFT of Uxbridge,	1900
Bristol County,	N. W. SHAW of North Raynham,	1899
Deerfield Valley,	F. H. SMITH of Ashfield,	1899
Eastern Hampden,	O. P. ALLEN of Palmer,	1900
Essex,	F. H. APPLETON of Peabody (P. O. Lynnfield),	1899
Franklin County,	F. L. WHITMORE of Sunderland,	1901
Hampshire,	GEO. P. SMITH of Sunderland,	1901
Hampshire, Franklin and Hampden,	EDWARD E. WOOD of Northampton,	1900
Highland,	SAMUEL M. RAYMOND of Hinsdale,	1899
Hillside,	C. K. BREWSTER of Worthington,	1899
Hingham (Agr'l and Hort'l),	EDMUND HERSEY of Hingham,	1900
Hoosac Valley,	N. B. BAKER of Savoy (P. O. Savoy Centre),	1900
Housatonic,	CHARLES B. BENEDICT of Egremont,	1900
Man'f'rs' Agr'l (No. Attleborough),	OSCAR S. THAYER of Attleborough,	1900
Marshfield (Agr'l and Hort'l),	WALTON HALL of Marshfield,	1900
Martha's Vineyard,	EVERETT A. DAVIS of West Tisbury,	1901
Massachusetts Horticultural,	E. W. WOOD of West Newton,	1900
Massachusetts Society for Promoting Agriculture,	N. I. BOWDITCH of Framingham,	1900
Middlesex North,	JOSHUA CLARK of Tewksbury,	1901
Middlesex South,	ISAAC DAMON of Wayland (P. O. Cochituate),	1899
Nantucket,	J. S. APPLETON, Jr., of Nantucket,	1900
Oxford,	J. W. STOCKWELL of Sutton,	1901
Plymouth County,	AUGUSTUS PRATT of North Middleborough,	1899
Spencer (Far's and Mech's Assoc'n),	J. ELTON GREEN of Spencer,	1901
Union (Agr'l and Hort'l),	ALMON W. LLOYD, of Blandford,	1901
Weymouth (Agr'l and Ind'l),	QUINCY L. REED of South Weymouth,	1900
Worcester,	J. LEWIS ELLSWORTH of Worcester,	1899
Worcester East,	W. A. KILBOURN of South Lancaster,	1900
Worcester North-west (Agr'l and Mech'l),	T. H. GOODSPEED of Athol (P. O. Athol Centre),	1901
Worcester South,	C. D. RICHARDSON of West Brookfield,	1901
Worcester County West,	E. A. HARWOOD of North Brookfield,	1899

Organization of the Board.

OFFICERS.

President, . . .	His Excellency ROGER WOLCOTT, *Ex Officio*.
1st Vice-President, .	JAMES S. GRINNELL of Greenfield.
2d Vice-President, .	ELIJAH W. WOOD of West Newton.
Secretary, . . .	WM. R. SESSIONS of Hampden.

Office, Rooms 134-136, State House, Boston.

COMMITTEES.

Executive Committee.

Messrs. E. W. Wood of West Newton.
W. A. Kilbourn of South Lancaster.
Isaac Damon of Wayland,
D. A. Horton of Northampton.
E. A. Harwood of North Brookfield.
Edmund Hersey of Hingham.
Francis H. Appleton of Peabody.

Committee on Agricultural Societies.

Messrs. W. A. Kilbourn of South Lancaster.
Q. L. Reed of South Weymouth.
N. W. Shaw of North Raynham.
O. P. Allen of Palmer.
N. B. Baker of Savoy.

Committee on Domestic Animals and Sanitation.

Messrs. Isaac Damon of Wayland.
F. H. Smith of Ashfield.
Oscar S. Thayer of Attleborough.
Joshua Clark of Tewksbury.
F. L. Whitmore of Sunderland.
Almon W. Lloyd of Blandford.

Committee on Gypsy Moth, Insects and Birds.

Messrs. E. W. Wood of West Newton.
Augustus Pratt of North Middleborough.
F. W. Sargent of Amesbury.
S. S. Stetson of Lakeville.
N. I. Bowditch of Framingham.

Committee on Dairy Bureau and Agricultural Products.

Messrs. D. A. Horton of Northampton.
J. L. Ellsworth of Worcester.
C. D. Richardson of West Brookfield.
C. B. Benedict of Egremont.
E. E. Wood of Northampton.

Committee on Agricultural College and Education.

Messrs. E. A. Harwood of North Brookfield.
John Bursley of West Barnstable.
C. K. Brewster of Worthington.
Wesley B. Barton of Dalton.
J. W. Stockwell of Sutton.
Geo. P. Smith of Sunderland.

Committee on Experiments and Station Work.

Messrs. Edmund Hersey of Hingham.
Walton Hall of Marshfield.
J. S. Grinnell of Greenfield.
T. H. Goodspeed of Athol.
J. Elton Green of Spencer.

Committee on Forestry, Roads and Roadside Improvements.

Messrs. Francis H. Appleton of Peabody.
S. M. Raymond of Hinsdale.
J. S. Appleton, Jr., of Nantucket.
E. A. Davis of West Tisbury.
Samuel B. Taft of Uxbridge.

The Secretary is a member, *ex officio*, of each of the above committees.

DAIRY BUREAU.

Messrs. D. A. Horton of Northampton, 1901, C. D. Richardson of West Brookfield, 1899. J. Lewis Ellsworth of Worcester, 1900, *appointed by the Governor*. Secretary Wm. R. Sessions, *Executive Officer*. Geo. M. Whitaker of Boston, *Assistant Executive Officer, appointed by the Governor*, 1899.

SPECIALISTS.

By Election of the Board.

Chemist, ...	Dr. C. A. Goessmann, ...	Amherst.
Entomologist, ...	Prof. C. H. Fernald, ...	Amherst.
Botanist and Pomologist, .	Prof. S. T. Maynard, ...	Amherst.
Veterinarian, ...	Prof. James B. Paige, ...	Amherst.
Engineer, ...	Wm. Wheeler, ...	Concord.
Ornithologist, ...	E. H. Forbush, ...	Malden.

By Appointment of the Secretary.

Librarian, F. H. Fowler, B.Sc., *First Clerk*.

MASSACHUSETTS AGRICULTURAL COLLEGE.

Location, Amherst, Hampshire County.

AGRICULTURAL SOCIETIES INCORPORATED BY SPECIAL ACT OF LEGISLATURE, AND REPRESENTED ON THE BOARD OF AGRICULTURE.

NAME.	PRESIDENT.	SECRETARY.	TREASURER.
Amesbury and Salisbury,*	C. W. Woods, Newbury.	A. H. Fielden, Amesbury.	J. A. Davis, Amesbury.
Barnstable County,	John Simpkins, Yarmouth.	T. C. Day, Barnstable.	A. F. Sherman, Barnstable.
Berkshire,	F. A. Palmer, Stockbridge.	Chas. H. Wright, Pittsfield.	J. W. Lewis, Pittsfield.
Blackstone Valley,	James Daley, Uxbridge.	Augustus Story, Uxbridge.	L. A. Seagrave, Uxbridge.
Bristol County,	N. J. W. Fish, Taunton.	Gertrude Williams, Taunton.	E. C. Holt, Taunton.
Deerfield Valley,	Chas. E. Ward, Buckland.	S. W. Hawkes, Charlemont.	E. F. Haskins, Charlemont.
Eastern Hampden,	A. D. Norcross, Monson.	F. D. Barton, Palmer.	F. D. Barton, Palmer.
Essex,	O. S. Butler, Georgetown.	J. M. Danforth, Lynnfield Centre.	G. L. Streeter, Salem.
Franklin County,	A. A. Smith, Colrain.	Henry J. Field, Greenfield.	Henry J. Field, Greenfield.
Hampshire,	A. M. Lyman, Montague.	Edward Conkey, Amherst.	Edward Conkey, Amherst.
Hampshire, Franklin and Hampden,	H. C. Comins, Hadley.	S. S. Warner, Northampton.	D. J. Wright, Northampton.
Highland,	Jonathan McElwain, Middlefield.	John T. Bryan, Middlefield.	M. J. Smith, Middlefield.
Hillside,	S. W. Clark, Cummington.	W. G. Atkins, West Cummington.	R. R. Packard, Cummington.
Hingham,*	E. L. Ripley, Hingham.	William H. Thomas, Hingham.	Reuben Sprague, Hingham.
Hoosac Valley,	Geo. Z. Dean, Cheshire.	George F. Miller, North Adams.	E. M. Meekins, North Adams.
Housatonic,	H. T. Robbins, Great Barrington.	Frank H. Briggs, Great Barrington.	O. C. Bidwell, Great Barrington.
Manufacturers' Agricultural,	S. O. Bigney, Attleborough.	Wm. H. Pond, Attleborough.	W. W. Sherman, N. Attleborough.
Marshfield,*	Walton Hall, Marshfield.	Francis Collamore, North Pembroke.	Francis Collamore, N. Pembroke.
Martha's Vineyard,	D. A. Cleaveland, West Tisbury.	B. T. Hillman, Edgartown.	Geo. H. Luce, West Tisbury.
Massachusetts Horticultural,	Francis H. Appleton, Peabody.	Robert Manning, Boston.	C. E. Richardson, Cambridge.
Massachusetts Society for Promoting Agriculture,	Chas. S. Sargent, Brookline.	Francis H. Appleton, Peabody.	J. C. Rogers, Boston.
Middlesex North,	H. J. Tolles, Dunstable.	E. T. Rowell, Lowell.	S. Drewett, Lowell.
Middlesex South,	Geo. L. Whitney, Sherborn.	Geo. C. Blades, South Framingham.	Edgar Potter, South Framingham.
Nantucket,	Joseph A. Johnson, Nantucket.	J. F. Murphey, Nantucket.	Asa C. Jones, Nantucket.
Oxford,	J. W. Stockwell, Sutton.	H. H. Sigourney, Oxford.	H. H. Sigourney, Oxford.
Plymouth County,	I. N. Nutter, E. Bridgewater.	Geo. M. Hooper, Bridgewater.	R. C. Breck, Bridgewater.
Spencer (Farmers' and Mechanics' Association),	T. J. Comins, Spencer.	H. H. Capen, Spencer.	A. W. Curtis, Spencer.

Union,*	Wm. H. Lewis, Blandford.	E. W. Boise, Blandford.	A. H. Nye, Blandford.
Weymouth (Ag'l and Ind.),	B. F. Poole, Rockland.	H. Wilbur Dyer, South Weymouth.	F. L. Bayley, South Weymouth.
Worcester,	W. C. Jewett, Worcester.	John B. Bowker, Worcester.	John B. Bowker, Worcester.
Worcester East,	John E. Thayer, Lancaster.	W. A. Kilbourn, South Lancaster.	Lucius Field, Clinton.
Worcester North-west (Ag'l and Mechanical),	A. F. Tyler, Athol.	A. F. Stratton, Athol.	T. H. Goodspeed, Athol Centre.
Worcester South,	A. B. Chamberlain, Sturbridge.	C. V. Corey, Sturbridge.	C. V. Corey, Sturbridge.
Worcester County West,	A. F. Adams, Barre Plains.	Matthew Walker, Barre.	- - -

* And horticultural.

HORTICULTURAL SOCIETIES.

NAME.	LOCATION.	PRESIDENT.	SECRETARY.
Cape Ann,	Gloucester,	Bennett Griffin, Gloucester.	William D. Lufkin, Gloucester.
Haverhill,	Haverhill,	Walter Goodrich, Haverhill.	Mrs. William M. Webster, Bradford.
Hampden County,	Springfield,	Edward P. Chapin, Springfield.	William F. Gale, Springfield.
Houghton,	Lynn,	Walter B. Allen, Lynn.	Miss Ruth S. Wood, Lynn.
Hyde Park,	Hyde Park,	Hugh J. Stockford, Hyde Park.	J. R. Andrews, Hyde Park.
Lenox,	Lenox,	George H. Thompson, Lenox.	E. Edwards, Lenox.
Massachusetts,	Boston,	Francis H. Appleton, Peabody.	Robert Manning, Boston.
Newton,	Newton,	L. H. Farlow, Newton.	L. H. Farlow, Newton.
Springfield, Amateur,	Springfield,	W. T. Hutchins, Indian Orchard.	Chas. L. Burr, Springfield.
Worcester County,	Worcester,	O. B. Hadwen, Worcester.	Adin. A. Hixon, Worcester.

Farmers' and Mechanics' Associations.

Bolton,	Bolton,	Henry F. Haynes, Bolton.	Wm. M. Brigham, Bolton.
Leominster,	Leominster,	George M. Kendall, Leominster.	C. C. Foster, Leominster.
Middlesex and Worcester,	Hudson,	Asa F. Hall, Hudson.	Josiah S. Welsh, Hudson.

AGRICULTURAL SOCIETIES INCORPORATED BY SPECIAL ACT OF LEGISLATURE, AND REPRESENTED ON THE BOARD OF AGRICULTURE.

NAME.	PRESIDENT.	SECRETARY.	TREASURER.
Amesbury and Salisbury,*	C. W. Woods, Newbury.	A. H. Fielden, Amesbury.	J. A. Davis, Amesbury.
Barnstable County,	John Simpkins, Yarmouth.	T. C. Day, Barnstable.	A. F. Sherman, Barnstable.
Berkshire,	F. A. Palmer, Stockbridge.	Chas. H. Wright, Pittsfield.	J. W. Lewis, Pittsfield.
Blackstone Valley,	James Daley, Uxbridge.	Augustus Story, Uxbridge.	L. A. Seagrave, Uxbridge.
Bristol County,	N. J. W. Fish, Taunton.	Gertrude Williams, Taunton.	E. C. Holt, Taunton.
Deerfield Valley,	Chas. E. Ward, Buckland.	S. W. Hawkes, Charlemont.	E. F. Haskins, Charlemont.
Eastern Hampden,	A. D. Norcross, Monson.	F. D. Barton, Palmer.	F. D. Barton, Palmer.
Essex,	O. S. Butler, Georgetown.	J. M. Danforth, Lynnfield Centre.	G. L. Streeter, Salem.
Franklin County,	A. A. Smith, Colrain.	Henry J. Field, Greenfield.	Henry J. Field, Greenfield.
Hampshire,	A. M. Lyman, Montague.	Edward Conkey, Amherst.	Edward Conkey, Amherst.
Hampshire, Franklin and Hampden,	H. C. Comins, Hadley.	S. S. Warner, Northampton.	D. J. Wright, Northampton.
Highland,	Jonathan McElwain, Middlefield.	John T. Bryan, Middlefield.	M. J. Smith, Middlefield.
Hillside,	S. W. Clark, Cummington.	W. G. Atkins, West Cummington.	R. R. Packard, Cummington.
Hingham,*	E. L. Ripley, Hingham.	William H. Thomas, Hingham.	Reuben Sprague, Hingham.
Hoosac Valley,	Geo. Z. Dean, Cheshire.	George F. Miller, North Adams.	E. M. Meekins, North Adams.
Housatonic,	H. T. Robbins, Great Barrington.	Frank H. Briggs, Great Barrington.	O. C. Bidwell, Great Barrington.
Manufacturers' Agricultural,	S. O. Bigney, Attleborough.	Wm. H. Pond, Attleborough.	W. W. Sherman, N. Attleborough.
Marshfield,*	Walton Hall, Marshfield.	Francis Collamore, North Pembroke.	Francis Collamore, N. Pembroke.
Martha's Vineyard,	D. A. Cleaveland, West Tisbury.	B. T. Hillman, Edgartown.	Geo. H. Luce, West Tisbury.
Massachusetts Horticultural,	Francis H. Appleton, Peabody.	Robert Manning, Boston.	C. E. Richardson, Cambridge.
Massachusetts Society for Promoting Agriculture,	Chas. S. Sargent, Brookline.	Francis H. Appleton, Peabody.	J. C. Rogers, Boston.
Middlesex North,	H. J. Tolles, Dunstable.	E. T. Rowell, Lowell.	S. Drewett, Lowell.
Middlesex South,	Geo. L. Whitney, Sherborn.	Geo. C. Blades, South Framingham.	Edgar Potter, South Framingham.
Nantucket,	Joseph A. Johnson, Nantucket.	J. F. Murphey, Nantucket.	Asa C. Jones, Nantucket.
Oxford,	J. W. Stockwell, Sutton.	H. H. Sigourney, Oxford.	H. H. Sigourney, Oxford.
Plymouth County,	I. N. Nutter, E. Bridgewater.	Geo. M. Hooper, Bridgewater.	R. C. Breck, Bridgewater.
Spencer (Farmers' and Mechanics' Association),	T. J. Comins, Spencer.	H. H. Capen, Spencer.	A. W. Curtis, Spencer.

Union,*	Wm. H. Lewis, Blandford.	E. W. Boise, Blandford.	A. H. Nye, Blandford.
Weymouth (Ag'l and Ind.),	B. F. Poole, Rockland.	H. Wilbur Dyer, South Weymouth.	F. L. Bayley, South Weymouth.
Worcester,	W. C. Jewett, Worcester.	John B. Bowker, Worcester.	John B. Bowker, Worcester.
Worcester East,	John E. Thayer, Lancaster.	W. A. Kilbourn, South Lancaster.	Lucius Field, Clinton.
Worcester North-west (Ag'l and Mechanical),	A. F. Tyler, Athol.	A. F. Stratton, Athol.	T. H. Goodspeed, Athol Centre.
Worcester South,	A. B. Chamberlain, Sturbridge.	C. V. Corey, Sturbridge.	C. V. Corey, Sturbridge.
Worcester County West,	A. F. Adams, Barre Plains.	Matthew Walker, Barre.	- - -

* And horticultural.

HORTICULTURAL SOCIETIES.

NAME.	LOCATION.	PRESIDENT.	SECRETARY.
Cape Ann,	Gloucester,	Bennett Griffin, Gloucester.	William D. Lufkin, Gloucester.
Haverhill,	Haverhill,	Walter Goodrich, Haverhill.	Mrs. William M. Webster, Bradford.
Hampden County,	Springfield,	Edward P. Chapin, Springfield.	William F. Gale, Springfield.
Houghton,	Lynn,	Walter B. Allen, Lynn.	Miss Ruth S. Wood, Lynn.
Hyde Park,	Hyde Park,	Hugh J. Stockford, Hyde Park.	J. R. Andrews, Hyde Park.
Lenox,	Lenox,	George H. Thompson, Lenox.	E. Edwards, Lenox.
Massachusetts,	Boston,	Francis H. Appleton, Peabody.	Robert Manning, Boston.
Newton,	Newton,	L. H. Farlow, Newton.	L. H. Farlow, Newton.
Springfield, Amateur,	Springfield,	W. T. Hutchins, Indian Orchard.	Chas. L. Burr, Springfield.
Worcester County,	Worcester,	O. B. Hadwen, Worcester.	Adin. A. Hixon, Worcester.

Farmers' and Mechanics' Associations.

Bolton,	Bolton,	Henry F. Haynes, Bolton.	Wm. M. Brigham, Bolton.
Leominster,	Leominster,	George M. Kendall, Leominster.	C. C. Foster, Leominster.
Middlesex and Worcester,	Hudson,	Asa F. Hall, Hudson.	Josiah S. Welsh, Hudson.

FARMERS' AND MECHANICS' ASSOCIATIONS — *Concluded.*

NAME.	LOCATION.	PRESIDENT.	SECRETARY.
Needham,	Needham,	William D. Rudd, South Natick.	Cyrus W. Jones, Needham.
Oakham	Oakham,	H. A. Crawford, Oakham.	Wm. S Crawford, Oakham.
Princeton,	Princeton,	J. C. F. Mirick, Princeton.	J. E. Merriam, Princeton.
Westminster,	Westminster,	E. C. Damon, Westminster.	Judson Foster, South Westminster.

FARMERS' AND MECHANICS' CLUBS.

NAME.	LOCATION.	PRESIDENT.	SECRETARY.
Ashburnham,	Ashburnham,	Chas. H. Gates, Ashburnham.	Chas. F. Packard, Ashburnham.
Ashby,	Ashby,	W. O. Loveland, Ashby.	W. J. Smith, Ashby.
Belchertown,	Belchertown,	D. F. Shumway, Belchertown.	Geo. H. B. Green, Belchertown.
Berlin,	Berlin,	P. B. Southwick, Clinton.	J. B. Southwick, Berlin Centre.
Groton,	Groton,	T. Lawrence Motley, Groton.	Charles Woolley, Groton.
Holden,	Holden,	Chas. T. Mead, Holden.	Alice L. Parker, Holden.
Pepperell,	Pepperell,	A. N. Blood, Pepperell.	S. R. Merrill, Pepperell.
Shirley,	Shirley,	H. S. Hazen, Shirley Centre.	- - -
Shrewsbury,	Shrewsbury,	E. A. Bartlett, Shrewsbury.	F. J. Stone, Shrewsbury.
West Acton,	West Acton,	Isaac Reed, West Acton.	Chas. B. Stone, West Acton.
Wilmington,	Wilmington,	Milton T. Holt, Wilmington.	Ed. M. Nichols, Wilmington.

FARMERS' CLUBS.

NAME.	LOCATION.	PRESIDENT.	SECRETARY.
Ashfield,	Ashfield,	John M. Sears, Ashfield.	A. G. Howes, Ashfield.
Boxborough,	Boxborough,	Frank A. Patch, West Acton.	J. F. Hayward, West Littleton.
Buckland,	Buckland,	F. H. Smith, Ashfield.	Eli C. Maynard, Buckland.
Chamberlain District,	Worcester,	Wm. J. Wheeler, Worcester.	S. A. Burgess, Worcester.
East Charlemont,	East Charlemont,	Horace Manning, East Charlemont.	Geo. H. Wheeler, East Charlemont.
Easthampton,	Easthampton,	E. H. Clark, Easthampton.	C. W. Smith, Easthampton.
Franklin,	Franklin,	Herbert H. Gates, Franklin.	L. W. Daniels, Franklin.
Halifax,	Halifax,	Jabez P. Thompson, Halifax.	Mrs. Geo. W. Hayward, Halifax.
Huntington,	Huntington,	C. H. Strong, Norwich.	H. W. Stickney, Norwich.

Lancaster,	Lancaster,	G. F. Morse, South Lancaster.	F. A. Hanaford, South Lancaster.
New Braintree,	New Braintree,	F. C. Barlow, Gilbertville.	C. P. McClanathan, Barre Plains.
New Salem,	New Salem,	D. F. Carpenter, Millington.	Willard Putnam, Cooleyville.
Practical,	Egremont,	Hermon T. Potts, South Egremont.	Mrs. L. T. Osborne, Alford.
Rehoboth,	Rehoboth,	Dr. C. N. Raymond, Rehoboth.	Chas. H. Goff, Rehoboth.
Rowley,	Rowley,	J. D. Dodge, Rowley.	T. P. Hale, Rowley.
Royalston,	Royalston,	- - -	G. E. Pierce, Royalston.
Rutland,	Rutland,	L. S. Dudley, West Rutland.	Mrs. W. G. Wales, Rutland.
South Bristol,	New Bedford,	Franklyn Howland, New Bedford.	A. P. R. Gilmore, Long Plain.
Sterling,	Sterling,	Joseph H. Kilburn, Sterling.	Ezra Sawyer, Sterling.
Tatnuck,	Worcester,	Elliott Moore, Worcester.	H. Ward Moore, Worcester.
Upton,	Upton,	Chas. A. Whitney, Upton.	P. W. Rockwood, Upton.
Waltham,	Waltham,	M. R. Leonard, Waltham.	A. Starbuck, Waltham.
West Bridgewater,	West Bridgewater,	F. E. Howard, West Bridgewater.	Anna S. Le Lacheur, W. Bridgewater.
West Brookfield,	West Brookfield,	W. E. Patrick, Warren.	L. H. Chamberlain, West Brookfield.
West Newbury,	West Newbury,	Ezekiel G. Nason, West Newbury.	A. L. Moore, West Newbury.
West Peabody,	West Peabody,	Mrs. F. C. Durkee, West Peabody.	Bertha G. Small, West Peabody.
Wilbraham,	Wilbraham,	B. L. Green, North Wilbraham.	H. M. Bliss, Wilbraham.

Miscellaneous.

Agricultural Library Association,	Swansea,	Samuel G. Arnold, Swansea Village.	Arthur E. Arnold, Swansea Centre.
Boston Market Gardeners' Association,	Boston and vicinity,	W. W. Rawson, Arlington.	- - -
Bristol Co. Fruit Growers' Association,	Dighton,	Joseph Gibbs, Pottersville.	Wm. P. Eddy, Dighton.
Bay State Agricultural Society,	Boston,	J. D. W. French, North Andover.	N. I. Bowditch, Framingham.
Brockton Agricultural Society,	Brockton,	H. W. Robinson, Brockton.	Baalis Sanford, Brockton.
Burlington Agricultural Society,	Burlington,	Edw. D. Bennett, Burlington.	H. H. Nichols, Burlington.
Cranberry Growers' Association,	Cape Cod district,	A. D. Makepeace, West Barnstable.	Franklin Crocker, Hyannis.
Farmers' and Gardeners' Club,	Hanson,	George F. Simpson, Hanson.	F. S. Thomas, M.D., Hanson.
Franklin Harvest Club,	Connecticut Valley,	Fred. L. Whitmore, Sunderland.	C. B. Lyman, Southampton.
Hampden Agricultural Society,	Springfield,	James T. Abbe, Springfield.	W. F. Gale, Springfield.
Hampden Harvest Club,	Connecticut Valley,	The members alternately.	J. N. Bagg, West Springfield.
Massachusetts Fruit Growers' Association,	The State,	Geo. Cruickshanks, Fitchburg.	S. T. Maynard, Amherst.
Middlesex East Agricultural Association,	Wakefield,	F. P. Bennett, Saugus.	Chas. Talbot, Montrose.
Westborough Agricultural Society,	Westborough,	John B. Fitch, Westborough.	George M. Howe, Westborough.
Worcester North Agricultural Society,	Fitchburg,	J. L. Harrington, Lunenburg.	John H. White, Lunenburg.
Young Men's Harvest Club,	Ludlow,	Chas. B. Bennett, Ludlow.	H. E. Miller, Ludlow.
Young People's Agricultural Club,	Wilbraham,	J. Alden Davis, East Longmeadow.	Charles H. Chesbro, Hampden.

Massachusetts Patrons of Husbandry.

Officers of the State Grange, 1898.

Master,	Warren C. Jewett of Worcester.
Overseer,	E. A. Emerson of Haverhill.
Lecturer,	George S. Ladd of Sturbridge.
Steward,	W. B. Barton of Dalton.
Assistant Steward,	J. B. Parkin of Holliston.
Chaplain,	Rev. C. S. Walker of Amherst.
Treasurer,	F. A. Harrington of Worcester.
Secretary,	Wm. N. Howard of South Easton.
Gate Keeper,	I. H. Lamb of Stoughton.
Pomona,	Mrs. Carrie C. Sabin of Amherst.
Flora,	Mrs. Emma S. Eaton of Fitchburg.
Ceres,	Miss Susie Wing of Littleton.
Lady Assistant Steward,	Mrs. S. Ella Southland of Athol.

Executive Committee.

Geo. L. Clemence,	Southbridge.
H. A. Barton,	Dalton.
C. A. Dennen,	Pepperell.

Deputies.

Marcellus Boynton,	Shawmut.
T. E. Flarity,	Townsend.
Herbert Sabin,	Amherst.
F. H. Stevens,	West Acton.
C. D. Richardson,	West Brookfield.
Charles G. Hinckley,	Lee.
Edward W. Fuller,	North Andover.
I. N. Day,	South Hadley.
John E. Gifford,	Sutton.
C. A. Stimson,	Royalston.
J. E. Goodell,	West Boylston.
George W. Roraback,	Westfield.
Charles H. Rice,	Leominster.
H F. Maxwell,	Canton.
Rev. A. W. Wheelock,	Millis.

Special Deputies.

Wm. N. Howard,	South Easton.
F. H. Plumb,	Springfield.

MASSACHUSETTS PATRONS OF HUSBANDRY — *Continued.*

NAME.	MASTER.	LECTURER.	SECRETARY.
Pomona Granges.			
Middlesex and Norfolk, No. 1,	John L. Fisher, Franklin.	Abel F. Stevens, Wellesley.	Mrs. Abel F. Stevens, Wellesley.
Essex County, No. 2,	Leonard W. Bradley, Haverhill.	Benjamin J. Balch, Topsfield.	Matilda B. Lund, West Boxford.
Middlesex and Worcester, No. 3,	T. E. Flarity, Townsend.	Mrs. Lizzie E. Starr, Groton.	Mrs. Annie E. Robbins, Lowell.
Franklin and Worcester, No. 4,	M. D. Herrick, North Orange.	Edward S. Young, Orange.	C. Waldo Bates, Phillipston.
Worcester West, No. 5,	Geo. S. Prouty, Hardwick.	J. H. Allen, Hubbardston.	Charles W. Snow, Nichewaug.
Berkshire, No. 6,	John S. Cole, Hinsdale.	Chas. Shaylor, Lee.	Agnes Y. Salter, Dalton.
Worcester Central, No. 7,	Lester H. Cudworth, Oxford.	S. A. Burgess, Worcester.	Mrs. Ellen M. Hayward, Millbury.
Hampshire County, No. 8,	Irving N. Day, South Hadley.	Rev. E. C. Winslow, Amherst.	Miss Sarah E. Mason, Northampton.
Worcester Southwest, No. 9,	C. L. Marsh, Webster.	Mary Olds Lakin, Brookfield.	Mrs. A. J. Thompson, Brookfield.
Worcester and Norfolk, No. 10,	W. O. Burden, Millville.	Mrs. Abbie Lapham, Mendon.	John E. Hollis, Uxbridge.
Borough, No. 11,	H. A. Wheeler, Berlin.	Mrs. Mary C. Graham, Westborough.	Mrs. Mary S. Wood, Northborough.
Springfield, No. 12,	W. S. Clark, Granby.	Mrs. C. C. Keep, Monson.	Mrs. C. L. Hayward, Agawam.
Old Colony, No. 13,	Ernest H. Gilbert, Stoughton.	H. F. Maxwell, Sharon.	Mrs. Geo. W. Stevens, South Braintree.
Worcester East, No. 14,	Andrew L. Nourse, Bolton.	Mrs. J. G. Warner, Boylston Centre.	Mrs. E. T. Cunningham, Lancaster.
Quabaug, No. 15,	W. E. Patrick, Warren.	A. C. Stoddard, North Brookfield.	A. A. Brigham, Brookfield.
Subordinate Granges.			
Northfield, No. 3,	Henry H. Mason, Northfield.	L. R. Smith, East Northfield.	Mabelle G. Kendrick, East Northfield.
Groton, No. 7,	Myron P. Swallow, Groton.	Mrs. Lizzie E. Starr, Groton.	Mrs. Olive M. Wilson, Groton.
Barre, No. 9,	Justin F. Rice, Barre.	Mrs. Geo. Johnson, Barre.	Geo. N. Harwood, Barre.
Amherst, No. 16,	C. L. Nims, Amherst.	Jennie M. Allen, Amherst.	Alice F. Dickinson, Amherst.
Hinsdale, No. 19,	C. C. Robinson, Jr., Hinsdale.	C. C. Robinson, Hinsdale.	John S. Cole, Hinsdale.
Westfield, No. 20,	Geo. W. Roraback, Westfield.	Chas. M. Gardner, Westfield.	Annette Sackett, Westfield.
Worcester, No. 22,	A. H. Bellows, Worcester.	Wm. K. Stanley, Worcester.	Ellen M. Flagg, Worcester.
Dalton, No. 23,	J. W. Fuller, Dalton.	H. N. French, Pittsfield.	W. H. Woodworth, Dalton.
Blandford, No. 24,	H. P. Robinson, Blandford.	H. T. Partree, M.D., Blandford.	Mrs. Emma J. Wyman, Blandford.
Easthampton, No. 27,	Geo. E. Searle, Easthampton.	Mrs. O. Harrington, Easthampton.	E. L. Shaw, Easthampton.
Middlefield, No. 33,	M. J. Smith, Middlefield.	Henry S. Pease, Middlefield.	Edwin H. Alderman, Middlefield.
Montgomery, No. 45,	L. O. Moore, Montgomery.	D. L. Allyn, Montgomery.	Agnes E. Morse, Montgomery.
Southwick, No. 46,	Nelson T. French, Southwick.	Mrs. H. L. Miller, Southwick.	Herbert L. Miller, Southwick.

MASSACHUSETTS PATRONS OF HUSBANDRY — *Continued.*

NAME.	MASTER.	LECTURER.	SECRETARY.
"Highland" of Huntington, No. 48,	James K. Axtell, Huntington.	- - -	J. W. Culver, Huntington.
Sterling, No. 53,	F. E. Willard, Sterling.	J. H. Kilburn, Sterling.	H. G. Thompson, Clinton.
Auburn, No. 60,	Geo. M. Allen, Auburn.	Mrs. W. H. Stockwell, West Millbury.	J. H. Prouty, Auburn.
"Union" of Belchertown, No. 64,	E. A. Randall, Belchertown.	J. B. Knight, Belchertown.	Mrs. M. G. Ward, Belchertown.
Brimfield, No. 65,	Orus E. Packard, Brimfield.	Mrs. Bessie F. Sherman, Brimfield.	Clarence B. Brown, Brimfield.
Hardwick, No. 67,	J. N. Hillman, Hardwick.	Mrs. E. C. Barnes, Hardwick.	F. E. Ruggles, Gilbertville.
Phillipston, No. 70,	Lucien Gove, East Templeton.	Wm. L. Wheeler, Templeton.	Mima B. Hager, Templeton.
Sunderland, No. 72,	Jesse L. Delano, Sunderland.	Mrs. R. E. Fairchild, Sunderland.	Miss Jessie C. Guilford, Sunderland.
"Prescott" of Pepperell, No. 73,	H. C. Gray, Pepperell.	Lucy E. Blood, Pepperell.	Fred O. Parker, East Pepperell.
Holden, No. 78,	A. L. Potter, Holden.	Mrs. G. S. Graham, Holden.	Mrs. S. N. Hubbard, Holden.
Spencer, No. 79,	Mrs. E. S. Bigelow, Spencer.	Mrs. Ida L. Warren, Spencer.	J. W. Bigelow, Spencer.
"Manhan" of Southampton, No. 82,	J. S. Frary, Southampton.	F. L. Hooker, West Holyoke.	Mrs. Geo. K. Edwards, Southampton.
North Orange, No. 86,	M. D. Herrick, North Orange.	Allie V. Bryant, Tully.	Martha A. Cheney, North Orange.
Lee, No. 88,	James E. Seacord, Lenox.	Mrs. Cora Dikeman, Lee.	Mrs. Flora Fenn, Lee.
Charlton, No. 92,	H. L. Clark, Southbridge.	E. M. Bowers, Charlton Depot.	George R. Taylor, Charlton.
Grafton, No. 93,	Harris G. Stowe, Grafton.	Miss Nellie J. Sinclair, Westborough.	E. S. Clark, Jr., Grafton.
Petersham, No. 95,	C. W. Snow, Nichewaug.	Mrs. F. M. Spooner, Petersham.	Mrs. M. E. Prouty, Petersham.
Shrewsbury, No. 101,	Geo. E. Brigham, Shrewsbury.	D. B. Rice, Shrewsbury.	Anne S. Rice, Shrewsbury.
Stow, No. 103,	F. H. Stevens, West Acton.	Mrs F. H. Stevens, West Acton.	Mrs. U. M. Lewis, Stow.
"Garfield" of North Dana, No. 104,	Moses T. Knapp, North Dana.	E. A. Albee, North Dana.	Ella E. Hanson, North Dana.
Marlborough, No. 105,	E. N. Stratton, Marlborough.	Elmer D. Howe, Marlborough.	Mrs, Elmer D. Howe, Marlborough.
West Boylston, No. 106,	Harry A. Harlow, West Boylston.	Mrs. V. A. Barker, West Boylston.	Fred B. Walker, West Boylston.
Millbury, No. 107,	Herbert McCracken, West Millbury.	Mabel R. Searles, Millbury.	C. H. Stockwell, West Millbury.
Hudson, No. 108,	L. W. Bruce, Hudson.	M. Belle Ordway, Hudson.	Mary E. Hall, Hudson.
Sutton, No. 109,	John E. Gifford, Sutton.	James W. Stockwell, Sutton.	Sarah M. Mills, Sutton.
Sherborn, No. 110,	D. L. Whitney, South Framingham.	Mercie P. Fleming, East Holliston.	Mrs. Geo. L. Whitney, S. Framingham.
Boylston, No. 111,	Munson C. Flagg, Boylston Centre.	Mrs. Chas. Bray, Boylston Centre.	Mrs. H. M. Andrews, Boylston Centre.
"East Medway" of Millis, No. 112,	J. Clarence Thorne, Millis.	Harriet P. Hooper, Millis.	Herbert H. Thorne, Millis.

Framingham, No. 113,	C. F. Hunt, Fayville.	Mrs. C. Trask, Framingham.	Mrs. Frank Warren, Framingham.
Medfield, No. 114,	Mrs. S. Minnie Chase, Medfield.	Amos H. Mason, Medfield.	Kate S. Preston, Medfield.
Holliston, No. 115,	Arthur W. Simpson, Holliston.	Mrs. Carrie A. Pond, Holliston.	Henry Leland, Holliston.
Westborough, No. 116,	A. M. Nourse, Westborough.	Mrs. Mary C. Graham, Westborough.	Mrs. Ella C. B. Leonard, Westborough.
Dover, No. 117,	James McGill, South Natick.	Edward A. James, Dover.	Fannie C. Paine, Dover.
Southborough, No. 118,	Edward F. Collins, Southborough.	Paul S. Lincoln, Southville.	Mrs. J. L. Byard, Southborough.
Northborough, No. 119,	Allyn D. Phelps, Northborough.	Mrs. Mary S. Wood, Northborough.	Mrs. Elsie J. Mills, Northborough.
Lancaster, No. 120,	Ella C. Divoll, Lancaster.	A. G. Currier, Clinton.	H. E. Currier, Clinton.
Sudbury, No. 121,	E. W. Goodnow, South Sudbury.	Mrs. A. J. Morse, Sudbury.	Mrs. Clara L. Parmenter, Sudbury.
Templeton, No. 122,	J. A. Braithwaite, Templeton.	P. F. French, Templeton.	Mrs. R. S. Titterton, Templeton.
Oxford, No. 123,	Charles L. Pettes, Oxford.	Mrs. Jennie S. M. Vinton, Oxford.	Miss Carrie M. Adams, North Oxford.
Ashland, No. 124,	David A. Burgess, Ashland.	Mrs. H. D. Stone, Ashland.	Fannie A. Pratt, Ashland.
Upton, No. 125,	William Harper, Upton.	Myrtice S. King, Upton.	L. Jennie Chapman, West Upton.
Hubbardston, No. 126,	Chas. C. Colby, Hubbardston.	J. Harry Allen, Hubbardston.	Mrs. Annie M. Leach, Hubbardston.
Amesbury, No. 127,	Geo. E. Battis, Amesbury.	John P. Titcomb, Amesbury.	Nellie A. Huntington, Amesbury.
North Andover, No. 128,	Arthur H. Farnham, Andover.	Dollie M. Farnum, North Andover.	W. H Hayes, North Andover Depot.
Gardner, No. 130,	Herbert F. Smith, South Gardner.	Miss Mabel R. Fisher, South Gardner.	Ada G. Hobby, Gardner.
Boxborough, No. 131,	R. Y. Nelson, West Acton.	Lucie C. Hager, West Acton.	Frank A. Patch, West Acton.
North Brookfield, No. 132,	Arthur C. Bliss, North Brookfield.	A. C. Stoddard, North Brookfield.	Minnie McCarthy, North Brookfield.
Berlin, No. 134,	H. A. Wheeler, Berlin.	Mrs. Hattie Brewer, Berlin.	Mrs. Fannie A. Jones, South Berlin.
Norfolk, No. 135,	Geo. B. Sims, Norfolk.	Geo. P. Holbrook, Norfolk.	Sarah B. Sims, Norfolk.
East Blackstone, No. 137,	O. F. Fuller, Blackstone.	Addie M. Stearns, Blackstone.	Malcolm D. Scott, Woonsocket, R. I.
Northampton, No. 138,	Edward P. West, Hadley.	Miss Miriam Allen, Northampton.	Miss Sarah E. Mason, Northampton.
East Sandwich, No. 139,	Mrs. R. S. Armstrong, East Sandwich.	J. F. Carleton, East Sandwich.	George Parker, East Sandwich.
West Boxford, No. 140,	Charles M. Moulton, South Groveland.	Mrs. Juliet Killam, West Boxford.	Matilda B. Lund, West Boxford.
Montague, No. 141,	Frank A. Dean, Montague.	Miss Bess E. Sheldon, Montague.	F. A. Rist, Montague.
Bolton, No. 142,	George E. Dow, Bolton.	Clara S. Walcott, Bolton.	Dorcas H. Babcock, Bolton.
Mendon, No. 143,	J. Newton Nutter, Mendon.	L. E. Taft, Mendon.	A. W. Gaskill, Mendon.
Franklin, No. 144,	J. L. Fisher, City Mills.	C. M. Allen, Franklin.	Alice A. Duprez, Franklin.
Douglas, No. 145,	Edwin Rawson, East Douglas.	Evie Benson, East Douglas.	Jennie F. Williams, East Douglas.
West Newbury, No. 146,	Leonard W. Bradley, W. Newbury.	Mrs. L. M. Newell, West Newbury.	Mrs. Annie Swap, West Newbury.
West Springfield, No. 147,	Ethan T. Likes, West Springfield.	Mrs. H. S. Phelps, Mitteneague.	Mrs. Helen L. Phelps, W. Springfield.
Swansea, No. 148,	A. E. Arnold, Swansea Centre.	Etta L. Gardner, Swansea Centre.	W. M. Sherman, Swansea Centre.
Harvard, No. 149,	Mrs. H. S. Stone, Still River.	Mrs. W. A Mentzer, Harvard.	Mrs. Alice S. Bigelow, Harvard.
Concord, No. 150,	O. E. Patch, Concord.	T. M. Barry, Concord.	Chas. E. Derby, Concord.

MASSACHUSETTS PATRONS OF HUSBANDRY — *Continued.*

NAME.	MASTER.	LECTURER.	SECRETARY.
Agawam, No. 151,	Geo. H. Reed, Agawam.	Mrs. W. H. Harmon, Agawam.	Mrs. C. L. Hayward, Agawam.
East Longmeadow, No. 152,	M. H. Pease, East Longmeadow.	Miss Rose Cope, East Longmeadow.	John L. Davis, East Longmeadow.
Wilbraham, No. 153,	H. W. Burbank, Wilbraham.	Chas. S. Merrick, Wilbraham.	Mrs. D. S. Bosworth, Wilbraham.
Haverhill, No. 154,	E. A. Emerson, Haverhill.	Frank J. Cunningham, Haverhill.	Elmina C. Gordon, Haverhill.
Methuen, No. 155,	Frank Buckminster, Methuen.	Hattie M. Sawyer, Methuen.	Mrs. Mary A. Crosby, Methuen.
West Bridgewater, No. 156,	George R. Drake, West Bridgewater.	Walter T. Packard, Campello.	H. B. Wilbur, West Bridgewater.
Granby, No. 157,	Mrs. Maud L. D. Clark, Granby.	W. S. Clark, Granby.	F. A. Forward, Granby.
"Nemasket" of Middleboro, No. 158,	Ichabod B. Thomas, Middleboro.	Chas. C. Tinkham, Middleborough.	Annie D. Deane, Middleborough.
"Green River" of Williamstown, No. 159,	J. F. Prindle, Williamstown.	Mrs. Wm. Crozier, Williamstown.	L. J. Gardner, Williamstown.
South Hadley, No. 160,	Mrs. E. S. Johnson, South Hadley.	Mrs. I. N. Day, South Hadley.	C. L. Johnson, Hadley.
"Laurel" of West Newbury, No. 161,	Annie L. Rogers, West Newbury.	Samuel E. Emery, D. D. S., Newburyport.	Sam Rogers, West Newbury.
Dartmouth, No. 162,	Irving C. Reed, South Dartmouth.	Chas. E. Soule, South Dartmouth.	Jabez H. Slocum, Dartmouth.
Dudley, No. 163,	F. S. Walker, Dudley.	Mrs. Hattie M. Marsh, Webster.	Dyer S. Elliott, Dudley.
Ware, No. 164,	George Lamberton, Ware.	Mrs. Y. C. Allen, Ware.	F. W. Harwood, Ware.
Hampden, No. 165,	Mrs. C. H. Burleigh, Hampden.	Miss Stella Day, Hampden.	Mrs. A. J. Tuttle, Hampden.
Wellesley, No. 166,	M. S. Keith, Wellesley Hills.	Frank Mills, Wellesley.	Mrs. Abel F. Stevens, Wellesley.
Somerset, No. 168,	H. W. Hathaway, Pottersville.	Miss L. A. Davis, Pottersville.	L. Esther Marble, Pottersville.
Lunenburg, No. 169,	J. L. Harrington, Lunenburg.	John Wooldredge, Lunenburg.	James Hildreth, Lunenburg.
New Braintree, No. 170,	F. W. Potter, New Braintree.	S. L. Dickinson, New Braintree.	M. F. Snow, Furnace.
Merrimac, No. 171,	B. L. Ford, Haverhill.	Mrs. W. B. Kelley, Merrimac.	John J. Woodman, Merrimac.
Ashby, No. 172,	Henry B. Houghton, Ashby.	Mrs. Lida M. Hayward.	Mrs. Ada A. Damon, Ashby.
Hopkinton, No. 173,	George W. Lincoln, Hopkinton.	Mrs. Mabel Thompson, Woodville.	Mrs. Mary A. Lincoln, Hopkinton.
Brookfield, No. 174,	Andrew A. Brigham, Brookfield.	Mrs. Sarah Mitchell, Brookfield.	Miss Cora B. Mitchell, Brookfield.
Athol, No. 175,	S. C. Perham, Athol Centre.	Mrs. Sarah Smith, Athol Centre.	Mrs. M. J. Tooley, Athol Centre.
"Millers River" of Orange, No. 176,	Geo. B. Lunt, Orange.	E. S. Young, Orange.	Elsie Saunders, Orange.
Sturbridge, No. 177,	Arthur P. Plimpton, Globe Village.	Mrs. Geo. S. Ladd, Sturbridge.	Mrs. C. L. Edgerly, Sturbridge.
Monson, No. 178,	A. M. Beebe, Monson.	Mrs. W. M. Tucker, Monson.	Omar Pease, Monson.
Ludlow, No. 179,	E. E. Chapman, Indian Orchard.	E. N. Fisher, Ludlow.	Lizzie C. Chapman, Indian Orchard.

West Brookfield, No 180,	Sumner H. Read, West Brookfield.	Mrs. E. K. Haskins, West Brookfield.	Miss Carrie A. Smith, West Brookfield.
Westport, No. 181,	Eldorus E. Weston, Central Village.	Ellen M. Smith, Westport Point.	Grace D. Tripp, Westport Point.
Southbridge, No. 182,	Wm. C. Cady, Southbridge.	Dr. W. G. Reed, Southbridge.	Mrs. Sarah E. Torrey, Southbridge.
Andover, No. 183,	Nathan R. Bailey, South Lawrence.	F. M. Hill, Andover.	A. L. Morrill, Andover.
Topsfield, No. 184,	C. J. Peabody, Topsfield.	Annah B. Jordan, Topsfield.	Mrs. Lillie Donaldson, Topsfield.
Fitchburg, No. 186,	John H. White, Fitchburg.	Mary A. Connig, Fitchburg.	Jennie M. Hills, Fitchburg.
"Satuit" of Scituate, No. 187,	Geo. E. Torrey, Norwell.	Fred J. Croning, Norwell.	Chas. O. Ellms, Greenbush.
Littleton, No. 188,	Osman Needham, Littleton Common.	Mrs. Nellie F. Johnson, Littleton.	Mrs. F. L. Litchfield, Littleton.
Warren, No. 189,	Wm. E. Patrick, Warren.	Mrs. H. N. Shepard, Warren.	H. N. Shepard, Warren.
Bellingham, No. 190,	Wm. P. Greenwood, South Milford.	Mrs. W. P. Greenwood, South Milford.	J. J. O'Sullivan, Bellingham.
Chestnut Hill, No. 191,	Wm. O. Burden, Blackstone.	Ruth L. Southwick, Mendon.	Mrs. Eleanor R. Tiffany, Millville.
Winchendon, No. 192,	Wm. E. Holden, Winchendon.	Mrs. Wm. E. Holden, Winchendon.	Edson B. Bemis, Winchendon.
Foxborough, No. 193,	Mrs. Martha J. Morse, Foxborough.	Geo. W. Scott, Foxborough.	Louis W. Hodges, Foxborough.
Townsend, No. 194,	F. J. Knight, Townsend Harbor.	E. F. Gates, Townsend.	G. A. Wilder, Townsend.
Royalston, No. 195,	L. G. Forbes, Royalston.	C. A. Stimson, Royalston.	Nellie M. Moore, Royalston.
Easton, No. 196,	Augustus Hopkins, North Easton.	J. W. Baldwin, North Easton.	Mrs. W. B. Drew, North Easton.
"Brookville" of Holbrook, No. 197,	Fred C. Hollis, Brookville.	E. E. Bowen, Brookville.	E. A. G. Hambly, Brookville.
Leominster, No. 198,	C. H. Rice, Leominster.	Mrs. C. A. Gates, North Leominster.	Grace M. Putnam, Leominster.
Stoughton, No. 199,	Ernest H. Gilbert, Stoughton.	Edna Tilden, Stoughton.	Roby M. Gilbert, Stoughton.
Uxbridge, No. 200,	C. B. Brown, Uxbridge.	Mrs. G. L. Taft, Uxbridge.	Mrs. C. B. Davis, Millville.
Bridgewater, No. 201,	Zeno Benson, Bridgewater.	Goulde E. Newcombe, Scotland.	Lucius C. Wood, Bridgewater.
Ashburnham, No. 202,	Henry W. Holman, Ashburnham.	Mrs. Ardella L. Packard, Ashburnham.	Ardella M. Jefts, Ashburnham.
Westminster, No. 203,	W. H. Waterhouse, Westminster.	Mrs. Ellen M. Hurd, Westminster Depot.	Mrs. J. L. Marshall, Westminster.
Rowley, No. 204,	John A. Marshall, Rowley.	Mrs. Abbie F. Ellsworth, Rowley.	Chas. A. Houghton, Rowley.
"Webster" of Marshfield, No. 205,	Geo. F. Wilson, North Marshfield.	Israel H. Hatch, North Marshfield.	Abbie L. Carver, Marshfield Hills.
Hanover, No. 206,	Albert J. Curtis, West Hanover.	Herman N. Knox, West Hanover.	Mrs. Hattie I. West, North Pembroke.
Tewksbury, No. 207,	H. W. Pillsbury, Tewksbury Centre.	George W. Trull, Lowell.	Miss Susie C. Whittemore, Tewksbury Centre.
Westford, No. 208,	W. J. Merritt, Coldspring.	Mrs. O. V. Roby, Westford.	J. W. Fletcher, Coldspring.
Hanson, No. 209,	W. O. Monroe, South Hanson.	Mrs. W. I. Holmes, North Hanson.	S. F. Turner, Hanson.
Shawmut, No. 210,	Chas. B. Phillips, Shawmut.	Mrs. Thomas Teffts, Shawmut.	Benj. S. Winslow, Shawmut.
Chicopee, No. 211,	Geo. H. Chapin, Chicopee Falls.	Gilbert Billings, Chicopee.	E. W. Chapin, Chicopee Falls.
"Oak Hill" of Attleborough, No. 212,	O. S. Thayer, Attleborough.	Mrs. E. V. Carpenter, Attleborough.	Mrs. A. R. Lewis, Pawtucket, R. I.
"Massapoag" of Sharon, No. 213,	Henry L. Narramore, Sharon.	Elmira B. Raynolds, Sharon.	Fannie A. Raynolds, Sharon.

MASSACHUSETTS PATRONS OF HUSBANDRY — *Continued.*

NAME.	MASTER.	LECTURER.	SECRETARY.
Agawam, No. 151,	Geo. H. Reed, Agawam.	Mrs. W. H. Harmon, Agawam.	Mrs. C. L. Hayward, Agawam.
East Longmeadow, No. 152,	M. H. Pease, East Longmeadow.	Miss Rose Cope, East Longmeadow.	John L. Davis, East Longmeadow.
Wilbraham, No. 153,	H. W. Burbank, Wilbraham.	Chas. S. Merrick, Wilbraham.	Mrs. D. S. Bosworth, Wilbraham.
Haverhill, No. 154,	E. A. Emerson, Haverhill.	Frank J. Cunningham, Haverhill.	Elmina C. Gordon, Haverhill.
Methuen, No. 155,	Frank Buckminster, Methuen.	Hattie M. Sawyer, Methuen.	Mrs. Mary A. Crosby, Methuen.
West Bridgewater, No. 156,	George R. Drake, West Bridgewater.	Walter T. Packard, Campello.	H. B. Wilbur, West Bridgewater.
Granby, No. 157,	Mrs. Maud L. D. Clark, Granby.	W. S. Clark, Granby.	F. A. Forward, Granby.
"Nemasket" of Middleboro, No. 158,	Ichabod B. Thomas, Middleboro.	Chas. C. Tinkham, Middleborough.	Annie D. Deane, Middleborough.
"Green River" of Williamstown, No. 159,	J. F. Prindle, Williamstown.	Mrs. Wm. Crozier, Williamstown.	L. J. Gardner, Williamstown.
South Hadley, No. 160,	Mrs. E. S. Johnson, South Hadley.	Mrs. I. N. Day, South Hadley.	C. L. Johnson, Hadley.
"Laurel" of West Newbury, No. 161,	Annie L. Rogers, West Newbury.	Samuel E. Emery, D. D. S., Newburyport.	Sam Rogers, West Newbury.
Dartmouth, No. 162,	Irving C. Reed, South Dartmouth.	Chas. E. Soule, South Dartmouth.	Jabez H. Slocum, Dartmouth.
Dudley, No. 163,	F. S. Walker, Dudley.	Mrs. Hattie M. Marsh, Webster.	Dyer S. Elliott, Dudley.
Ware, No. 164,	George Lamberton, Ware.	Mrs. Y. C. Allen, Ware.	F. W. Harwood, Ware.
Hampden, No. 165,	Mrs. C. H. Burleigh, Hampden.	Miss Stella Day, Hampden.	Mrs. A. J. Tuttle, Hampden.
Wellesley, No. 166,	M. S. Keith, Wellesley Hills.	Frank Mills, Wellesley.	Mrs. Abel F. Stevens, Wellesley.
Somerset, No. 168,	H. W. Hathaway, Pottersville.	Miss L. A. Davis, Pottersville.	L. Esther Marble, Pottersville.
Lunenburg, No. 169,	J. L. Harrington, Lunenburg.	John Wooldredge, Lunenburg.	James Hildreth, Lunenburg.
New Braintree, No. 170,	F. W. Potter, New Braintree.	S. L. Dickinson, New Braintree.	M. F. Snow, Furnace.
Merrimac, No. 171,	B. L. Ford, Haverhill.	Mrs. W. B. Kelley, Merrimac.	John J. Woodman, Merrimac.
Ashby, No. 172,	Henry B. Houghton, Ashby.	Mrs. Lida M. Hayward.	Mrs. Ada A. Damon, Ashby.
Hopkinton, No. 173,	George W. Lincoln, Hopkinton.	Mrs. Mabel Thompson, Woodville.	Mrs. Mary A. Lincoln, Hopkinton.
Brookfield, No. 174,	Andrew A. Brigham, Brookfield.	Mrs. Sarah Mitchell, Brookfield.	Miss Cora B. Mitchell, Brookfield.
Athol, No. 175,	S. C. Perham, Athol Centre.	Mrs. Sarah Smith, Athol Centre.	Mrs. M. J. Tooley, Athol Centre.
"Millers River" of Orange, No. 176,	Geo. B. Lunt, Orange.	E. S. Young, Orange.	Elsie Saunders, Orange.
Sturbridge, No. 177,	Arthur P. Plimpton, Globe Village.	Mrs. Geo. S. Ladd, Sturbridge.	Mrs. C. L. Edgerly, Sturbridge.
Monson, No. 178,	A. M. Beebe, Monson.	Mrs. W. M. Tucker, Monson.	Omar Pease, Monson.
Ludlow, No. 179,	E. E. Chapman, Indian Orchard.	E. N. Fisher, Ludlow.	Lizzie C. Chapman, Indian Orchard.

West Brookfield, No 180,	Sumner H. Read, West Brookfield.	Mrs. E. K. Haskins, West Brookfield.	Miss Carrie A. Smith, West Brookfield.
Westport, No. 181,	Eldorus E. Weston, Central Village.	Ellen M. Smith, Westport Point.	Grace D. Tripp, Westport Point.
Southbridge, No. 182,	Wm. C. Cady, Southbridge.	Dr. W. G. Reed, Southbridge.	Mrs. Sarah E. Torrey, Southbridge.
Andover, No. 183,	Nathan R. Bailey, South Lawrence.	F. M. Hill, Andover.	A. L. Morrill, Andover.
Topsfield, No. 184,	C. J. Peabody, Topsfield.	Annah B. Jordan, Topsfield.	Mrs. Lillie Donaldson, Topsfield.
Fitchburg, No. 186,	John H. White, Fitchburg.	Mary A. Connig, Fitchburg.	Jennie M. Hills, Fitchburg.
"Satuit" of Scituate, No. 187,	Geo. E. Torrey, Norwell.	Fred J. Croning, Norwell.	Chas. O. Ellms, Greenbush.
Littleton, No. 188,	Osman Needham, Littleton Common.	Mrs. Nellie F. Johnson, Littleton.	Mrs. F. L. Litchfield, Littleton.
Warren, No. 189,	Wm. E. Patrick, Warren.	Mrs. H. N. Shepard, Warren.	H. N. Shepard, Warren.
Bellingham, No. 190,	Wm. P. Greenwood, South Milford.	Mrs. W. P. Greenwood, South Milford.	J. J. O'Sullivan, Bellingham.
Chestnut Hill, No. 191,	Wm. O. Burden, Blackstone.	Ruth L. Southwick, Mendon.	Mrs. Eleanor R. Tiffany, Millville.
Winchendon, No. 192,	Wm. E. Holden, Winchendon.	Mrs. Wm. E. Holden, Winchendon.	Edson B. Bemis, Winchendon.
Foxborough, No. 193,	Mrs. Martha J. Morse, Foxborough.	Geo. W. Scott, Foxborough.	Louis W. Hodges, Foxborough.
Townsend, No. 194,	F. J. Knight, Townsend Harbor.	E. F. Gates, Townsend.	G. A. Wilder, Townsend.
Royalston, No. 195,	L. G. Forbes, Royalston.	C. A. Stimson, Royalston.	Nellie M. Moore, Royalston.
Easton, No. 196,	Augustus Hopkins, North Easton.	J. W. Baldwin, North Easton.	Mrs. W. B. Drew, North Easton.
"Brookville" of Holbrook, No. 197,	Fred C. Hollis, Brookville.	E. E. Bowen, Brookville.	E. A. G. Hambly, Brookville.
Leominster, No. 198,	C. H. Rice, Leominster.	Mrs. C. A. Gates, North Leominster.	Grace M. Putnam, Leominster.
Stoughton, No. 199,	Ernest H. Gilbert, Stoughton.	Edna Tilden, Stoughton.	Roby M. Gilbert, Stoughton.
Uxbridge, No. 200,	C. B. Brown, Uxbridge.	Mrs. G. L. Taft, Uxbridge.	Mrs. C. B. Davis, Millville.
Bridgewater, No. 201,	Zeno Benson, Bridgewater.	Goulde E. Newcombe, Scotland.	Lucius C. Wood, Bridgewater.
Ashburnham, No. 202,	Henry W. Holman, Ashburnham.	Mrs. Ardella L. Packard, Ashburnham.	Ardella M. Jefts, Ashburnham.
Westminster, No. 203,	W. H. Waterhouse, Westminster.	Mrs. Ellen M. Hurd, Westminster Depot.	Mrs. J. L. Marshall, Westminster.
Rowley, No. 204,	John A. Marshall, Rowley.	Mrs. Abbie F. Ellsworth, Rowley.	Chas. A. Houghton, Rowley.
"Webster" of Marshfield, No. 205,	Geo. F. Wilson, North Marshfield.	Israel H. Hatch, North Marshfield.	Abbie L. Carver, Marshfield Hills.
Hanover, No. 206,	Albert J. Curtis, West Hanover.	Herman N. Knox, West Hanover.	Mrs. Hattie I. West, North Pembroke.
Tewksbury, No. 207,	H. W. Pillsbury, Tewksbury Centre.	George W. Trull, Lowell.	Miss Susie C. Whittemore, Tewksbury Centre.
Westford, No. 208,	W. J. Merritt, Coldspring.	Mrs. O. V. Roby, Westford.	J. W. Fletcher, Coldspring.
Hanson, No. 209,	W. O. Monroe, South Hanson.	Mrs. W. I. Holmes, North Hanson.	S. F. Turner, Hanson.
Shawmut, No. 210,	Chas. B. Phillips, Shawmut.	Mrs. Thomas Teffts, Shawmut.	Benj. S. Winslow, Shawmut.
Chicopee, No. 211,	Geo. H. Chapin, Chicopee Falls.	Gilbert Billings, Chicopee.	E. W. Chapin, Chicopee Falls.
"Oak Hill" of Attleborough, No. 212,	O. S. Thayer, Attleborough.	Mrs. E. V. Carpenter, Attleborough.	Mrs. A. R. Lewis, Pawtucket, R. I.
"Massapoag" of Sharon, No. 213,	Henry L. Narramore, Sharon.	Elmira B. Raynolds, Sharon.	Fannie A. Raynolds, Sharon.

MASSACHUSETTS PATRONS OF HUSBANDRY — *Concluded.*

NAME.	MASTER.	LECTURER.	SECRETARY.
Walpole, No. 214, . . .	Julius Guild, Walpole.	William Roberts, South Walpole.	Miss Edith R. Ellis, Walpole.
Mattapoisett, No. 215, . .	Edwin F. Hammond, E. Mattapoisett.	Mrs. Alice W. Ashley, Mattapoisett.	Asa R. Swift, Mattapoisett.
Dracut, No. 216, . . .	Geo. A. H. Richardson, Pawtucket-ville.	Calvin Richardson, Lowell.	Mrs. Norman L. Peavey, Lowell.
Mansfield, No. 217, . . .	Joseph W. Leonard, Mansfield.	Miss S. M. Barker, Norton.	Mrs. J. W. Leonard, Mansfield.
Norton, No. 218, . . .	Geo. E. Smith, East Norton.	Mrs. Geo. E. Smith, East Norton.	Charles T. Oldfield, Norton.
East Princeton, No. 219, . .	Oliver Osgood, East Princeton.	Mrs. A. L. Stuart, East Princeton.	Dana F. Ward, East Princeton.

INDEX TO SECRETARY'S REPORT.

PUBLIC DOCUMENT . . . . No. 33.

TENTH ANNUAL REPORT

OF THE

HATCH EXPERIMENT STATION

OF THE

MASSACHUSETTS AGRICULTURAL COLLEGE.

JANUARY, 1898.

BOSTON:
WRIGHT & POTTER PRINTING CO., STATE PRINTERS,
18 POST OFFICE SQUARE.
1898.

HATCH EXPERIMENT STATION

OF THE

MASSACHUSETTS AGRICULTURAL COLLEGE,

AMHERST, MASS.

By act of the General Court, the Hatch Experiment Station and the State Experiment Station have been consolidated under the name of the Hatch Experiment Station of the Massachusetts Agricultural College. Several new divisions have been created and the scope of others has been enlarged. To the horticultural has been added the duty of testing varieties of vegetables and seeds. The chemical has been divided, and a new division, "Foods and Feeding," has been established. The botanical, including plant physiology and disease, has been restored after temporary suspension.

The officers are: —

HENRY H. GOODELL, LL.D.,	*Director.*
WILLIAM P. BROOKS, Ph.D.,	*Agriculturist.*
GEORGE E. STONE, Ph.D.,	*Botanist.*
CHARLES A. GOESSMANN, Ph.D., LL.D.,	*Chemist* (fertilizers).
JOSEPH B. LINDSEY, Ph.D.,	*Chemist* (foods and feeding).
CHARLES H. FERNALD, Ph.D.,	*Entomologist.*
SAMUEL T. MAYNARD, B.Sc.,	*Horticulturist.*
J. E. OSTRANDER, C.E.,	*Meteorologist.*
HENRY M. THOMSON, B.Sc.,	*Assistant Agriculturist.*
RALPH E. SMITH, B.Sc.,	*Assistant Botanist.*
HENRI D. HASKINS, B.Sc.,	*Assistant Chemist* (fertilizers).
CHARLES I. GOESSMANN, B.Sc.,	*Assistant Chemist* (fertilizers).
GEORGE D. LEAVENS, B.Sc.,	*Assistant Chemist* (fertilizers).
EDWARD B. HOLLAND, B.Sc.,	*Assistant Chemist* (foods and feeding).
FRED W. MOSSMAN, B.Sc.,	*Assistant Chemist* (foods and feeding).
BENJAMIN K. JONES, B.Sc.,	*Assistant in Foods and Feeding.*
ROBERT A. COOLEY, B. Sc.,	*Assistant Entomologist.*
G. A. DREW, B. Sc.,	*Assistant Horticulturist.*
H. D. HEMENWAY, B.Sc.,	*Assistant Horticulturist.*
H. H. ROPER, B.Sc.,	*Assistant in Foods and Feeding.*
A. C. MONAHAN,	*Observer.*

The co-operation and assistance of farmers, fruit g
horticulturists and all interested, directly or indire
agriculture, are earnestly requested. Communicatio
be addressed to the "Hatch Experiment Station, A
Mass."

The following bulletins are still in stock and
furnished on demand: —

No. 27. Tuberculosis in college herd; tuberculin in di
bovine rabies; poisoning by nitrate of soda.
No. 28. Canker, army and corn worms; red-humped a
caterpillar; antiopa butterfly; currant stem
imported elm-bark louse; greenhouse orthezi
No. 29. Fungicides and insecticides; new spraying pum
ing calendar.
No. 33. Glossary of fodder terms.
No. 35. Agricultural value of bone meal.
No. 36. Imported elm-leaf beetle; maple pseudococcu
sphinx; San José scale.
No. 37. Report on fruits, insecticides and fungicides.
No. 38. Fertilizer analyses; composition of Paris gree
of muriate of potash on the lime resources of
No. 41. On the use of tuberculin (translated from Dr. E
No. 42. Fertilizer analyses; fertilizer laws.
No. 43. Effects of electricity on germination of seeds.
No. 44. Variety tests of fruits; tests of vegetable seeds
No. 45. Commercial fertilizers; fertilizer analyses;
laws.
No. 46. Habits, food and economic value of the Americ
No. 47. Field experiments with tobacco.
No. 48. Fertilizer analyses.
No. 49. Fertilizer analyses.
Special bulletin, — The brown-tail moth.
Index, 1888–95.

Of the other bulletins, a few copies remain, wh
only be supplied to complete sets for libraries.

The work during the year has been unusually di
in its character and importance, a result of the n
problems sent in for solution. In the agricultural d
soil tests with corn and potatoes grown in several l
have been continued; a comparison of different fe

een made; "Nitragin" has again been tried, with neg- results; and an interesting test has been carried on of y varieties of corn, eighty-one of potatoes, sixty of s, twenty-one of millets and four of clover.

the division of chemistry (fertilizers), aside from the undred analyses of licensed fertilizers and manurial nces, valuable work has been done for the tobacco- rs of the Connecticut valley in the analyses of tobacco grown with different fertilizers, testing of the quality and burning quality, and suggestions as to methods nting, fertilizers to be employed and mechanical prep- n of the soil.

he botanical division, investigations have been carried the brown rot of stone fruit, the chrysanthemum rust, af blights of certain native trees, as the sycamore, nut, chestnut and black cherry, with recommendations atment for the brown rot and chrysanthemum rust.

horticultural division has continued its work of test- rieties of fruit and seeds of vegetables, and has entered an investigation of the use of hydrocyanic acid as an cide.

m the entomological division have issued two impor- ulletins on the habits, food and economic value of the can toad and the brown-tail moth. A monograph on ume-moths (some varieties of which attack plants of nic value and those raised for ornamental purposes) een completed. The superiority of spraying for the worm over ink bands and oil troughs has been dem- ted, and investigations carried on of new insecticides vhich to assail the gypsy moth.

eries of observations for the electrical determination isture in the soil, in connection with the growth n, were undertaken by the meteorological division. to breaks in the circuit and other causes that made strument fail to work, and the abnormally wet weather summer, the results were not entirely satisfactory, e observations will be repeated the coming season.

ee investigations in the division of foods and feeding rthy of special note: (a) On the comparative values

of corn meal and hominy and cerealine feeds for p
duction, when fed in combination with skim-milk.
found that the pigs did quite as well on these feeds
equal amount of corn meal. (*b*) On salt-marsh
was found to possess less feeding value than Engl
but, combined with grain and ensilage, produced n
much milk and butter as an equal amount of Eng
thus combined. (*c*) On cotton-seed feed as a hay
tute for milch cows. More energy was used up i
gestion than in hay, and it was concluded that Massa
farmers would derive no benefit from feeding this
in place of hay.

Reports of the different divisions, giving in de
work of the year, accompany this brief summary.

ANNUAL REPORT

ORGE F. MILLS, *Treasurer* OF THE HATCH EXPERIMENT STATION OF MASSACHUSETTS AGRICULTURAL COLLEGE,

For the Year ending June 30, 1897.

eceived from United States treasurer,		$15,000 00
aid for salaries,	$5,087 75	
for labor,	3,312 26	
for publications,	2,354 06	
for postage and stationery,	264 11	
for freight and express,	245 78	
for heat, light and water,	193 31	
for seeds, plants and sundry supplies,	600 55	
for feeding stuffs,	185 11	
for library,	1,139 85	
for tools, implements and machinery,	272 21	
for furniture and fixtures,	33 43	
for scientific apparatus,	226 83	
for live stock,	125 45	
for travelling expenses,	352 32	
for contingent expenses,	42 73	
for building and repairs,	564 25	
		$15,000 00
hand July 1, 1896,	$1,042 92	
ed from State treasurer,	10,000 00	
from fertilizer fees,	4,087 75	
from farm products,	1,934 15	
from miscellaneous sources,	1,022 19	
		$18,087 01
aid for salaries,	$10,784 83	
for labor,	1,075 81	
for publications,	175 03	
for postage and stationery,	156 18	
for freight and express,	187 48	
for heat, light and water,	361 64	
nount carried forward,	$12,740 97	

Amount brought forward,	$12,740 97
Cash paid for chemical supplies,	592 48
for seeds, plants and sundry supplies,	515 54
for fertilizers,	1,074 41
for feeding stuffs,	559 24
for library,	61 82
for tools, implements and machinery,	28 62
for furniture and fixtures,	176 12
for scientific apparatus,	357 48
for live stock,	359 45
for travelling expenses,	72 72
for contingent expenses,	273 03
for building and repairs,	1,255 40
Cash on hand June 30, 1897,	19 73
	$1

AMHERST, MASS., Aug. 3

I, Charles A. Gleason, duly appointed auditor of the corporation, c certify that I have examined the books and accounts of the Hatch E Station of the Massachusetts Agricultural College for the fiscal year endin 1897; that I have found the books well kept and the accounts correctly cl above; and that the receipts for the year are shown to be $33,087.01, and sponding disbursements $33,067.28. All the proper vouchers are on file been by me examined and found to be correct, there being a balance of accounts of the fiscal year ending June 30, 1897.

CHARLES A. GLEASO

PORT OF THE AGRICULTURIST.

WILLIAM P. BROOKS.

Soil Tests.

soil tests upon the plan heretofore followed were ed during the past year; viz., with corn in Norwell ntague, with potatoes and with onions (and later s) upon our home grounds. Only the tests in Nor-d with potatoes upon our home grounds were suc-y carried through.

vorable weather conditions destroyed the onions and s upon our south soil-test acre. The field was sown mustard late in July. But four plots furnished t growth to cut and weigh; viz., lime plot, 1 manure plot, 425 pounds; nitrate and dissolved ack, 45 pounds; potash and dissolved bone-black, ds; nitrate, dissolved bone-black and potash plot, nds,—all green weights.

ield has now been used nine years in soil-test work, have a high degree of one-sided exhaustion on most lots. The close dependence of the mustard upon a of phosphoric acid (furnished by the bone-black) is out, as was the case in 1895; but phosphoric acid n no longer produce any growth of mustard upon . The addition of either nitrogen or potash helps ormer most; but not much growth is produced un-three are supplied.

oil test with corn in Montague was ruined by wire worms. As nearly as could be determined from the of the crop left, nitrogen seemed the most neces-ment upon this soil.

1. *Soil Test with Corn. Norwell.*

This is the second year of soil-test work in this fi crop last year also being corn. Last year potash v controlling element; the result this year is the same riate of potash, at the rate of 160 pounds per acre, g average increase at the rate of 36.3 bushels of gra 2,203 pounds of stover; nitrate of soda, at the sam per acre, gives an average increase of 8.3 bushels o and 325 pounds of stover; dissolved bone-black, at t of 320 pounds per acre, gives an average increase bushels of grain and 455 pounds of stover. Five c manure increase the crop by 26.4 bushels of gra 3,450 pounds of stover per acre; complete fertiliz trate, dissolved bone-black and potash at above rates an increase of grain 52.5 bushels and stover 2,455 p lime and plaster both produce apparent small increas

2. *Soil Test with Potatoes. Amherst.*

The field upon which this test was carried out lie our own grounds. It has a medium, well-drained loa has been seven years in soil-test experiments. Th in order of succession have been potatoes, corn, soya oats, grass and clover (two years), and cabbages and ish turnips. This year the phosphoric acid gives the average increase in crop, viz., at the rate of 26.6 bus merchantable tubers per acre; nitrogen gives an i of 11.3 bushels merchantable tubers and potash an i of 7.2 bushels. The soil, however, is very genera hausted, and no single fertilizer or combination of two or all three gave a good crop. The apparent riority of the phosphoric acid and nitrogen is chiefly the fact that the plot to which those two elements were applied was for some reason (not believed to effect of the fertilizer alone) nearly twice as great upon any other plot. Had the crop where the pota added to the nitrogen and phosphoric acid been be even as good as that where the phosphoric acid and ni alone were used, we should be justified in the con

the nitrogen and phosphoric acid are the elements
fly required. The crop where all three elements were
bined was, however, much inferior to that where the
ogen and phosphoric acid were used without potash.
must therefore conclude that some disturbing factor, at
ent unknown, influenced the results; and we are, there-
unable to draw practical conclusions which throw light
the proper practice to be followed in manuring the
to crop.

MANURE ALONE v. MANURE AND POTASH.

n experiment in continued corn culture for the com-
on of an average application of manure with a small
cation of manure used in connection with muriate of
sh was begun in 1890. A full account of the results
be found in the annual reports of 1890–95, and in the
r year a general summary of the results is given.

e land used in this experiment was seeded with a
ure of timothy, red-top and clover in the standing corn
ly of last year. A good stand of grass and clover
secured, although the latter was rather unevenly devel-
in different parts of the field, suggesting a possible
of thoroughness in mixing the seeds.

manure or potash has been used this year. The field
des four plots of one-fourth of an acre each. The
ts for 1897 are shown below: —

t 1 (1½ cords of manure alone, 1890–96): hay, 1,420 pounds;
, 783 pounds.

t 2 (1 cord manure and 40 pounds of muriate of potash,
-96): hay, 885 pounds; rowen, 483 pounds.

t 3 (manure alone, as for Plot 1): hay, 1,380 pounds;
, 785 pounds.

t 4 (manure and potash, as for Plot 2): hay, 1,037½ pounds;
, 590 pounds.

e averages are as follows: —

ts 1 and 3 (manure alone, 1890–96): hay, 1,403½ pounds;
, 784 pounds.

ts 2 and 4 (manure and potash, 1890–96): hay, 961¼ pounds;
, 536½ pounds.

Combining the figures showing the averages of hay rowen, we find that plots 1 and 3 have produced an ave of 2,187 pounds per plot, which is at the rate of 4 tons pounds, per acre. Plots 2 and 4 have produced an ave of 1,497¼ pounds per plot, which is at the rate of 9 po less than 3 tons per acre. The larger quantity of ma then, produced this year about 1⅛ tons more per acre the manure and potash. This is a large difference, difference which was to be anticipated, in view of the larger quantity of plant food which has been appli these plots. It remains to be seen whether the clove plots 2 and 4 will be capable of so enriching the so nitrogen as to remove or lessen this difference in suc ing years.

"Special" Corn Fertilizer v. Fertilizer riche Potash.

This experiment was begun with a view of comparin results obtained with a fertilizer proportioned like the age of the "*special*" *corn fertilizers* found upon our kets in 1891 with those obtained with a fertilizer rich potash but furnishing less nitrogen and phosphoric aci

Corn was grown during each of the years from 18 1896 inclusive. From 1891 to 1895 it was found tha fertilizer richer in potash gave the more profitable res In 1896 there was no practical difference. It was de during the season of 1896 that it might be possible to d a greater benefit from the larger quantity of potash ap to two of the four plots if grass and clover should be g in rotation with the corn. Accordingly the land was se with a mixture of timothy, red-top and clover in the st ing corn in July, 1896. The field is divided into four p of one-fourth of an acre each. The materials applied t several plots are shown in the following table: —

FERTILIZERS.	Plots 1 and 3 (Pounds each).	Plots 2 and 4 (Pounds each).
te of soda, ...	20	18
l blood, ...	30	30
ground fish, ...	30	20
superphosphate, ...	226	120
ate of potash, ...	22.5	60
of materials per plot, ...	$3 23	$3 10

ertilizers were applied evenly broadcast on April 11.
he yields the past year are shown below: —

ot 1, "special" fertilizer: hay, 795 pounds; rowen, 130 nds.

ot 2, fertilizer richer in potash: hay, 810 pounds; rowen, pounds.

ot 3, "special" fertilizer: hay, 725 pounds; rowen, 97 nds.

ot 4, fertilizer richer in potash: hay, 617 pounds; rowen, pounds.

he average yield on plots 1 and 3 is: hay, 760 pounds; en, 113½ pounds. On plots 2 and 4: hay, 713½; rowen, pounds. Putting the crops of hay and rowen together, have an average from 1 and 3 of 873½ pounds, and from nd 4 of 860½ pounds. The difference, 13 pounds, is small to be regarded as of much significance. The ter rowen crop produced by plots 2 and 4 is perhaps e attributed to the larger amount of potash which has n applied to these plots, which favors especially the wth of the clovers. Inequality of moisture conditions, ever, has been the apparent cause of a very uneven elopment of clover on different parts of the field, and influence of the potash does not show as clearly as anticipated.

Natural Phosphates compared with Each Other with Acid Phosphate. (Field F.)

This series of experiments was begun by Dr. Goess in 1890, with a view of determining whether it is not profitable to employ one of the cheaper natural phosp than to use the more costly acid phosphate. A full ac of the experiment and the results obtained up to the e 1896 is given by Dr. Goessmann in our ninth annual re It is only necessary to restate the following points: —

The field was at first divided into five plots, conta about 6,600 square feet each. These plots received money's worth (on the basis of prices in 1890) of the phates used, as follows: Plot 1, phosphatic slag; Pl Mona guano; Plot 3, at first, apatite; later, Florida phate; Plot 4, South Carolina phosphate; Plot 5, diss bone-black. Plot 3, as above stated, received an ap tion of ground apatite in 1890. In 1891 it was foun possible to obtain this material, and no phosphate o kind was applied to this plot. In 1892 and 1893 gr hard Florida phosphate was applied to this plot. It i believed, however, that it is fair to this phosphate to co it with the others, since it has been used only two y while the others have been applied for four years.

From the beginning, each of these five plots has rec the same application of nitrate of soda and potash-mag sulphate. The quantities of these applied per plot d the first four years were about 44 pounds of the forme 66 pounds of the latter.*

Since 1894 no phosphate of any kind has been ap to these plots, but the quantity of nitrate of soda an potash-magnesia sulphate has been used in one-half gr quantities.

At first Dr. Goessmann included no plot on which phate was not used for comparison with others. Later a plot was added, but it was left entirely unmanured 1896. During 1896 and 1897 it has received the nitra

* The plots in this experiment differ from each other by a few square feet and the fertilizers have from the beginning varied in proportion as the size va

nd potash-magnesia sulphate at the same rate as the plots.

yield of the plots receiving phosphate for each of ears 1890–96 inclusive will be found in our ninth report. This report also contains a statement show-e amounts of phosphoric acid applied and removed each plot during each of these years. This statement an excess added over and above that removed from f the plots at the end of the season of 1896 as follows: phosphatic slag had been used, the amount of phos- acid remaining was 65.6 pounds; where Mona guano en used, 44.2 pounds; where apatite and Florida phos- had been used, 141.7 pounds; where South Carolina hosphate had been used, 115.0 pounds; and where acid hate had been used, 21.8 pounds.

crop during the past year was Swedish turnips. The ad been sown with rye for winter protection in the 1896. The growth of the rye was characterized as It was ploughed on June 1, the land was harrowed 2d, and on the 3d of June, Laing's Swedes were sown ls two feet apart. The seed germinated promptly and , but the season was much too wet for the best growth crop. It was, however, kept free from weeds by fre- cultivation. The crop was thinned on June 20 to inches. It was harvested November 2–4. The tur- ere poor in quality, small, and a few of them decayed. yields of the several plots were as follows: —

	Roots (Pounds).	Tops (Pounds).
no phosphate, ...	830	185
phosphatic slag, ...	1,870	480
Mona guano, ...	3,655	800
Florida hard phosphate, . . .	820	400
South Carolina rock phosphate, .	1,965	560
dissolved bone-black, . . .	1,619	370

It will be noticed that the crop on the phosphati
Mona guano and South Carolina rock surpasses that
dissolved bone-black was used, and that the Mona
gives nearly twice the product obtained by either th
or the South Carolina rock. It will be further notice
the Florida phosphate yields practically the same a
of roots as the plot receiving no phosphate. None
crops secured this year can be regarded as good.
largest yield, that on the Mona guano plot, is at the r
rather less than 12 tons per acre. A good crop sho
about 20 tons per acre. The results of this year, the
although showing marked differences, are not regar
decisive. The peculiarities of the season produced
healthy condition, which interfered with the full act
the fertilizers employed.

Comparison of Different Phosphates.

The results of the experiments inaugurated by Dr.
mann for the comparison of different phosphates wi
phosphate having proved so interesting and valuable,
decided to inaugurate another series of experiments, i
ing a greater number of materials supplying phos
acid. It was further thought best to apply these ma
upon the basis of equal quantities of phosphoric acid
plot, rather than on the basis of equal money's worth
the experiments planned by Dr. Goessmann.

The land selected for the experiment was fairly
with a medium heavy loam. It had been in grass fo
years. In April, 1896, it received an application
pounds of ground bone and 200 pounds of muriate of
per acre. The season was very dry, and the grass
little benefit from the fertilizers. The grass was cu
the middle of June, and the field was ploughed on J
and 25, 1896, and planted to Longfellow corn. T
was cut when in the milk, September 26, and weig
put into the silo. The field had been divided into 1
of one-eighth of an acre each, separated by suita
manured strips. The yields of corn in 1896 were
lows: —

1, 2,640 pounds; Plot 2, 2,990 pounds; Plot 3, 2,915 ; Plot 4, 3,555 pounds; Plot 5, 2,885 pounds; Plot 6, pounds; Plot 7, 2,850 pounds; Plot 8, 3,020 pounds; 3,160 pounds; Plot 10, 3,095 pounds; Plot 11, 3,000 ; Plot 12, 3,090 pounds; Plot 13, 3,440 pounds.

e weights were taken with a view to determining r these plots were fairly even in fertility. It will iced that with three exceptions, plots 1, 4 and 13, pears to be the case. Plot 1 is apparently poorer e average, while plots 4 and 13 are better.

397 the soil was thoroughly prepared by the use of eel harrow. Fertilizers were applied May 11. Each the field received the following materials: potash-sia sulphate, 50 pounds; nitrate of soda, 30¼ pounds; e of potash, high grade, 12½ pounds. These ma- supplied the potash and nearly all the nitrogen ed to be required. Some of the phosphates to be ed (the bone meals), however, contained nitrogen as phosphoric acid, and, to equalize conditions on all ots, sufficient hoof meal was applied to those not ng bone to make the quantity of nitrogen applied to lot throughout the field the same.

plots contained, as stated, one-eighth of an acre each, e materials used furnished to each plot phosphoric 2 pounds; nitrogen, 6½ pounds; potash, 19 pounds. fertilizers used per plot (in addition to nitrate of nd sulphate of potash which were used alike on each ed above) are shown below: —

1: hoof meal, 11¾ pounds. Plot 2: hoof meal, 11¾ ; apatite, 32 pounds. Plot 3: hoof meal, 11¾ pounds; Carolina rock phosphate, 47 pounds. Plot 4: hoof meal, unds; Florida soft phosphate, 45½ pounds. Plot 5: hoof 1¾ pounds; slag, 67¼ pounds. Plot 6: hoof meal, 11¾ ; Navassa phosphate, 49 pounds. Plot 7: hoof meal, unds. Plot 8: hoof meal, 11¾ pounds; dissolved bone-70 pounds. Plot 9: hoof meal, $\frac{6}{16}$ pound; raw bone 5 pounds. Plot 10: hoof meal, $1\frac{3}{16}$ pounds; dissolved neal, 73¼ pounds. Plot 11: steamed bone meal, 48¼ . Plot 12: hoof meal, 11¾ pounds; acid phosphate, 90½ . Plot 13: hoof meal, 11¾ pounds.

The variety of corn raised was Sibley's Pride
North, which was planted on May 17, replanted as
necessary on June 1, and thinned to one plant per
the drill early in June. The extraordinary precipita
the season kept the soil too wet the greater part of t
during the month of July, and the crop was prevente
doing its best. It was cut and stooked September
husked about the last of October.

The yield per plot and the calculated rates per a
shown below: —

NAMES.	Corn (Pounds).	Stover (Pounds).	Corn per Acre (Bushels).
Plot 1, no phosphate, . . .	585	580	58.500
Plot 2, apatite, ...	565	475	56.500
Plot 3, South Carolina rock phosphate	645	535	64.500
Plot 4, Florida soft phosphate, .	725	620	72.500
Plot 5, phosphatic slag, . .	620	620	62.000
Plot 6, Navassa phosphate, . .	678¼	610	67.825
Plot 7, no phosphate, . . .	643¼	542	64.325
Plot 8, dissolved bone-black, .	618¼	548	61.825
Plot 9, raw bone meal, . . .	673¼	570	67.325
Plot 10, dissolved bone meal, .	633¼	550	63.325
Plot 11, steamed bone meal,. .	503¼	450	50.325
Plot 12, acid phosphate, . .	628¼	540	62.825
Plot 13, no phosphate, . . .	673¼	590	67.325

It will be noticed that one of the best crops in t
was produced where no phosphate was used, and t
yield on the plots to which phosphates were applie
without apparent relation to the availability of th
phoric acid in the materials used. Under these
stances, extended discussion of the results is not cal

nfavorable influence of the season and possible differ- in natural fertility of the soil serve to obscure the of the phosphates employed.

INOUS CROPS (CLOVER, PEA AND BEAN, OR "POD" AMILY) AS NITROGEN GATHERERS. (FIELD A.)

ull history of the field since 1884 is given by Dr. nann in our ninth annual report. The years 1884–88 preparatory; the experiment proper began in 1889. jects in view have been:—

To determine the extent to which plants of the clover are capable of enriching the soil in nitrogen taken m from the air through the agency of the nodular a found upon their roots.

To compare nitrate of soda, sulphate of ammonia, lood and barn-yard manure as sources of nitrogen.*

field is divided into eleven $\frac{1}{10}$ acre plots, numbered to 10. Three plots, 4, 7 and 9, have received no tion of nitrogen-containing manure or fertilizer since One (0) has received barn-yard manure; two (1, 2), of soda; three (5, 6, 8), sulphate of ammonia; and , 10), dried blood every year since 1889. These ls have been used in such amounts as to furnish n at the rate of 45 pounds per acre each year. All ots have received, yearly, equal amounts of phos- acid and potash. The quantities applied have fur- , per acre, phosphoric acid 80 pounds, and potash ounds, from 1889 to 1894 and the past season. In nd 1896 double these quantities were used. Dr. nann reports: †—

total yield of crops on the plots receiving no nitrogen, as ed with those receiving nitrogen, was in the several years ws:—

With corn in 1889, one-fifth less.
With oats in 1890, one-fifth to one-sixth less.
With rye in 1891, one-fifth to one-sixth less.
With soya beans in 1892, one-third to one-fourth less.

---

such details are given here as are necessary to a general understanding of ct; full information is found, as stated above, in our ninth annual report.
h annual report, Hatch Experiment Station, page 175.

In 1893 the crop was oats, and the yield of gra
from one-seventh to one-eighth less on the plots re
no nitrogen than the average of those receiving nit
Here the interposition of a leguminous crop (soya b
1892) appears to have lessened the proportional infe
of the plots which received no nitrogen. In 1894 th
was again the soya bean. The plots without nitroge
a yield about one-third less than the average of the
Thus far it will be seen that the soya bean has not
that degree of independence of soil nitrogen of whi
supposed to be capable. To an even greater degre
the grain crops it is benefited by nitrogen manuring.
fact may perhaps be accounted for because of conditio
favorable to bacterial life in this soil; but as to the
of such unfavorable conditions we are at present igno

In 1895 the crop was oats, and results showed
provement in proportional yield on the plots receiv
nitrogen which could be attributed to the precedin
crop. This may be in part due to the fact that the be
a rather limited root system, and leaves behind bu
stubble.

In 1896 the crop was again the soya bean, whic
more showed marked inferiority on the no-nitrogen
An attempt to seed the land to clover in the standing
proved a failure, on account of the dry season and t
dense shade made by the crop of beans.

The crop the past season has been oats. The yie
plot of straw and grain, the rate per acre and remark
the quality of the grain are given below. In this tab
no-nitrogen plots are italicised.

Nitrogen Experiment.

PLOT.	Weight per Plot One-tenth Acre.		Yield per Acre.		Remarks on Grain.
	Straw (Pounds).	Oats (Pounds).	Straw (Pounds).	Oats (Bushels).	Kernels.
of soda, . .	500	159	5,000	49.68	Light.
of soda, . .	400	147	4,000	45.93	Light.
lood, . .	215	122	2,150	38.12	Good.
ogen, . .	*120*	*69*	*1,200*	*21.56*	Good.
e of ammonia, .	340	137	3,400	42.81	Poorer than No. 3.
e of ammonia, .	275	97	2,750	30.31	Good.
ogen, . .	*120*	*77½*	*1,200*	*24.21*	Good.
e of ammonia, .	350	127	3,500	39.68	Good.
ogen, . .	*130*	*75*	*1,300*	*23.43*	Good.
lood, . .	220	126	2,200	39.37	Fair.
rd manure, .	220	125	2,200	39.06	Fair.

culation shows that the average total weight of crop is less than one-half as great on the plots not manured itrogen as the average of the other plots. The crop in is a little more than one-half as great. We find, not the least evidence of any ability on the part of the ean when grown before a grain crop (and harvested) ke nitrogen manuring of the grain crop unnecessary. e contrary, the proportional yield of the no-nitrogen s this year the lowest it has ever been in these experi-

Relative Value of the Different Manures furnishing Nitrogen.

nitrate of soda gives the largest crop. Next in order ld come the barn-yard manure, dried blood and sul- of ammonia; but between these there is not much nce. On plots 2, 3, 4, 6, 7, 8 and 9 the source of is the muriate; on all others it is double sulphate of

potash-magnesia. The yield of oats is in every i
greater where the sulphate is used under otherwise
manuring. The superiority is most marked when s
of ammonia is the source of nitrogen.

MURIATE COMPARED WITH SULPHATE OF POTASH NECTION WITH SULPHATE OF AMMONIA FOR CO

Results obtained with different crops in the specia gen tests on Field A during previous years having in an injurious effect, due to the combination of mur potash and sulphate of ammonia,* it was decided to take experiments upon a larger scale, with the view o ing out more clearly the significance or importance effect. Accordingly two plots of land of one-half ac lying on the east side of the highway, were set ap this experiment. This land had previously been experiments to determine the relative value of pho slag and ground bone as sources of phosphoric acid. experiments were begun in 1894 and continued unti The crops had been oats, corn and millet. An acc these experiments will be found in the annual report ing the years named.

The following fertilizers were applied this year, cast, after ploughing, and harrowed in: —

North plot: sulphate of ammonia, 152 pounds; mu potash, 120 pounds; acid phosphate, 160 pounds.

South plot: sulphate of ammonia, 152 pounds; sul potash, 120 pounds; acid phosphate, 160 pounds.

The fertilizers were applied May 11. The cr planted in drills three and one-half feet apart, M The variety was Sibley's Pride of the North.

The soil throughout the season was too wet for t growth of the corn crop. The crop was harvested tember 6, and put into the silo. The yield was as f

* For a full discussion of this subject see Dr. Goessmann's paper in t report of the Hatch Experiment Station for 1897, pages 222 and 223.

ı plot, 5,760 pounds; south plot, 5,255 pounds. The rence is too small to afford a basis for a positive judg- . as to the merits of the two forms of potash applied.

Fertilizers for Garden Crops.

1891 Dr. Goessmann began a series of experiments ıe comparison of sulphate of ammonia, nitrate of soda dried blood as sources of nitrogen for various garden . Sulphate of potash was employed to furnish potash. 92 the scope of the experiment was enlarged by includ- hree additional plots, comparing the same materials as es of nitrogen with muriate of potash used as a source tash. The results of these experiments are fully dis- d in Dr. Goessmann's reports. The following table s the different fertilizers applied to the several plots: —

PLOTS.	Annual Supply of Manurial Substances.	Pounds.
, ...	Sulplate of ammonia, . .	38
	Muriate of potash, . .	30
	Dissolved bone-black, .	40
, ...	Nitrate of soda, . . .	47
	Muriate of potash, . .	30
	Dissolved bone-black, .	40
, ...	Dried blood, . . .	75
	Muriate of potash, . .	30
	Dissolved bone-black, .	40
, ...	Sulphate of ammonia, .	38
	Sulphate of potash, . .	30
	Dissolved bone-black, .	40
, ...	Nitrate of soda, . . .	47
	Sulphate of potash, . .	30
	Dissolved bone-black, .	40
, ...	Dried blood, . . .	75
	Sulphate of potash, . .	30
	Dissolved bone-black, .	40

e area of the plots is about one-eighth of an acre each. fertilizers used supply at the rates per acre: phos- ic acid, 50.4 pounds; nitrogen, 60 pounds; potash, 120 ds.

The crops raised during the past year were garde[n]
beets, squashes and celery.

Garden Peas. — The land was ploughed April 19
izers applied and harrowed in April 21, and the seed
on April 22. On June 7 it was noticed that the gro
the vines on Plot 1 was distinctly inferior to that
other plots, and it so continued throughout the
The pods produced by the vines upon this plot wer
but well filled, as were they also upon Plot 4. The
of vines upon plots 3 and 6 may be characterized
dium; upon plots 2 and 5 the growth was rank. T
upon these two plots were large, but not well filled.
pickings of peas were made. The yield of green
well as of vines, is shown in the following table: —

Green Peas (Pounds).

DATE.	MURIATE OF POTASH.			SULPHATE O	
	Plot 1.	Plot 2.	Plot 3.	Plot 4.	Plot
July 12, ...	100	93	99½	165	17
July 19, ...	66	150	132	143	13
July 23, ...	11	60	49	40	3
	177	203	280½	348	34

Green Vines (Pounds).

July 23, ...	102½	210	240	240	20

The average yield of green peas produced by the
fertilizers is shown in the following table: —

	Po
Average of muriate plots, ...	2
Average of sulphate plots, ...	3
Average of sulphate of ammonia plots, . . .	2
Average of nitrate of soda plots, ...	2
Average of dried blood plots, ...	2

It will be noticed that the sulphate of potash app
be distinctly superior to the muriate, that the drie
gives a larger crop than either of the other sources

but that there is not a great difference between the materials used to supply this element. The best crop oduced where sulphate of ammonia and sulphate of h are used. The crop where nitrate of soda and sul- of potash are used is not, however, materially in- .

ts. — The variety raised was the Eclipse. Fertilizers applied as stated above, seed planted April 22, vacan- lled May 20. The growth of the beets upon Plot 1 oticed early in the season to be distinctly inferior to n the other plots, and before the close of the season of the plants upon this plot were dead. On July 27 op was harvested. The yield of the several plots was lows: Plot 1, 133 pounds; Plot 2, 711 pounds; Plot 3 pounds; Plot 4, 448 pounds; Plot 5, 793½ pounds; 5, 478 pounds.

e averages of the different fertilizers are shown be- —

	Pounds.
Average of muriate plots,	400⅔
Average of sulphate plots,	573⅙
Average of sulphate of ammonia plots,	290½
Average of nitrate of soda plots,	752¼
Average of dried blood plots,	418

will be noticed that the sulphate of potash appears to eatly superior to the muriate, and nitrate of soda is far of sulphate of ammonia as a source of nitrogen for rop. The best yield is produced where nitrate of soda ulphate of potash are used together.

uashes and Celery. — Both of these crops were failures, count of the unfavorable weather. The celery plants, rue, lived, but many of them made no growth. The s were cut close to the ground on October 18, many em being, if anything, smaller than when set. The gs were weighed, with the following results: Plot 1, ounds; Plot 2, 57 pounds; Plot 3, 35½ pounds; Plot pounds; Plot 5, 92 pounds; Plot 6, 24 pounds.

is noticeable that here again Plot 5, where nitrate of and sulphate of potash were used, is the best; but this did not produce a crop with any marketable value.

Injurious Effect of Sulphate of Ammonia and I of Potash used together. — Particular attention is to the fact that upon Plot 1, where sulphate of ar and muriate of potash are used together, the growth the case of the peas and beets, decidedly inferior upon the other plots. This inferiority may undoubt ascribed to the poisonous effect of the chloride of ar formed where these fertilizers are used together, to Dr. Goessmann has called especial attention.

Experiments on Grass Land.

The system of manuring grass lands, planned by Dr. mann and described by him in previous reports, ha continued. According to this system, the land recei year a dressing of barn-yard manure at the rate of per acre; the next year, wood ashes at the rate of 1 acre; and the third year, ground bone 600 poun muriate of potash 200 pounds, per acre.

Plot 1, which this year received ashes, gave a yiel rate of 5,775 pounds of hay and 3,204 pounds of ro acre, — a total of 4 tons 979 pounds. Plot 2, wh ceived manure applied in the fall of 1896, produce rate of 5,784 pounds of hay and 2,627 pounds of ro acre, — a total of 4 tons and 411 pounds. Plot 3 this year received bone and potash, produced at the 6,183 pounds of hay and 2,755 pounds of rowen pe — a total of 4 tons 938 pounds.

This system of using these different manures fo lands in rotation has much to recommend it. It is and has certainly given remarkably good crops. I however, that the system would be improved by the a little nitrate of soda, say 150 pounds per acre, w ashes as well as with the bone and potash.

Experiments with Nitragin, a Germ Fertili

Nitragin, prepared according to the directions of sor Nobbe, was imported at my suggestion from G in the summer of 1896. The material was fully de

ἰoessmann in our last annual report, and full direc- its use are quoted by him.

itragin has been tried in accordance with directions, elsewhere in this report, upon crimson clover and rithout apparent benefit. It has also been tried nmon red clover. On this crop, as with the others, ence in growth attributable to the nitragin has been and, so far as can be judged at the present time, of this germ fertilizer for our common clovers is not vised. Nitragin undoubtedly contains the germs of opriate nodular bacteria, — the name of Professor s sufficient guarantee of this. The failure of the to benefit the crop appears to be due to the fact soils contain the nodular bacteria of the common ous crops in sufficient numbers so that the addition more by the use of nitragin counts for nothing. nce in the open field in most parts of Germany and has been similar to our own, and I believe that we ly conclude that only when we are about to begin ure of a leguminous crop new to a particular local- it be found advantageous to employ nitragin. In es the soil lacks the appropriate nodular bacteria; furnishes these, and the result is a better growth, the crop is enabled to make use of the free nitrogen r from the first, which it could not do in the absence roper bacteria.

Sulphate of Iron as a Fertilizer.

ate of iron has been tried during the past season same plots as in 1896, but this year with corn as a The sulphate of iron is used at the rate of 80 pounds . The crop where it was employed was a little to that on the plots where it was not used. With- hate of iron the average yield of the plots was 58¼ of corn and 163¼ pounds of stover; with sulphate 50¾ pounds of corn and 160 pounds of stover.

Variety Tests.

1. *Corn.*

Twenty of the more promising varieties of corn tr the first time last year have been given a further tri ing the past season. Nine of these varieties we corns, as follows, named in the order of producti Sanford, Longfellow, Waushakum, Giant Long Rhode Island White Cap, Early Canada, King Phili gel of Midnight, Compton's Early. The varieties corn, named in order of productiveness, were Early Leaming Field, Champion White Pearl, Queen Prairie, Iowa Gold Mine, King of the Earlies, Sibley' of the North, South Dakota White, Huron Extra Wisconsin Yellow and White Cap Yellow.

Varieties the ears of which were very moist when are Queen of the Prairie and Huron Extra Early. ties which were moist are White Cap Dent, Leaming Iowa Gold Mine and Champion White Pearl.

All of the varieties in these two classes are too l culture as grain crops in this locality, though they do for the silo.

2. *Potatoes.*

Eighty-one varieties of potatoes were cultivated f poses of comparison upon the general plan described last report (ninth). The soil was a well-drained n loam. The fertilizers used per acre were as follows

	Pou
Nitrate of soda,	2
Acid phosphate,	4
Sulphate of potash (high grade),	2
Tankage,	2
Dried blood,	1

These materials were mixed and scattered broadly furrows before dropping the seed. The seed was April 30. May 5 the crop was somewhat injured by ing of the soil between the rows and by the excessiv fall. The potatoes were dug September 26 to Oct The yield was at the rate of from 115.7 to 282.4 per acre. The eleven largest yields of merchantable

order of productiveness, were given by the following
es: Rose No. 9, Restaurant, Woodbury's White,
Triumph, Prolific Rose, Empire State, Early Maine,
ı Red, Sir William, Early Rose and Beauty of
n. All of these gave a product at the rate of more
20 bushels of merchantable tubers per acre. Again,
year, we find the two old standard sorts, Early Rose
eauty of Hebron, ranking among the very best. It
s doubtful whether any among all those tried are
uperior to these varieties.

nty-three varieties have given yields of merchantable
at the rate of less than 175 bushels per acre. These,
order of inferiority, are the following: Minister,
Yye, Harbinger, Peerless, Jr., Livingston Banner,
e's Extra Early, Carmen No. 3, Dandy, Early Mar-
Crown Jewel, Merriman, White Star, Irish Daisy,
e, Six Weeks, Alliance, Sunlit Star, World's Fair,
ıan, Ohio, Jr., Great Divide, Wise Seedling and
Norther.

of the varieties grown this year are to be examined
termination of dry matter and starch, but this work
not be completed in season for this report. Full
s as to the varieties cultivated are therefore reserved
hese analytical results can be published.

3. *Grasses.*

ty species and varieties of grasses have been under
Most of them occupied plots containing one square
About one-half of these grasses were sown in the
g of 1896. Among those so sown the following varie-
vinter-killed: English rye grass, Italian rye grass,
d dog's-tail and meadow fescue. Among compar-
y little-cultivated varieties which appear promising
e mentioned the following: tall oat grass, tall fescue,
escue, fowl meadow, Canada blue-grass, water-spear
and wood-meadow grass.

yield of the dry matter in the hay and rowen (where
as secured) of those varieties sown in the spring of
during the past season, with date of cutting of both

the first and the second crops, is shown in the foll
table. The area in each variety was one square rod.

KINDS.	Date of cutting Hay.	Dry Matter in Hay (Pounds).	Date of cutting Rowen.
Timothy (*Phleum pratensis*), .	July 1,	19.36	Sept. 11,
Awnless Broom (*Bromus inermis*),	June 25,	14.71	Sept. 11,
Yellow Oat (*Avena flavescens*), .	July 1,	-	Sept. 11,
Sweet Vernal (*Anthoxanthum odoratum*).	June 4,	2.98	Sept. 11,
Meadow Foxtail (*Alopecurus pratensis*).	May 17,	5.70	June 25,
Red-top (*Agrostis vulgaris*),. .	July 6,	31.12	Sept. 11,
Rhode Island Bent (*Agrostis Canina*).	July 6,	30.81	Sept. 11,
Fall Oat (*Arrhenatheum avenaceum*).	June 25,	22.85	Sept. 11,
Glyceria fluitans, ...	July 1,	-	Sept. 11,
Meadow soft (*Holcus lanatus*), .	June 25,	10.25	Sept. 11,
Slender Fescue (*Festuca tennuifolia*).	June 15,	21.43	-
Meadow Fescue (*Festuca pratensis*).	Sept. 11,	4.36	-
Sheep's Fescue (*Festuca ovina*), .	June 15,	27.85	Sept. 11,
Tall Fescue (*Festuca elatior*), .	June 25,	27.20	Sept. 11,
Hard Fescue (*Festuca durinscula*),	June 15,	27.42	Sept. 11,
Orchard (*Dactylis glomerata*), .	June 15,	16.41	Sept. 11,
Red Fescue (*Festuca rubra*), .	June 25,	27.47	Sept. 11,
Fowl Meadow (*Poa serotina*), .	July 6,	43.00	Sept. 11,
Rough-stalked Meadow (*Poa trivialis*).	July 1,	9.87	Sept. 11,
Kentucky Blue (*Poa pratensis*), .	June 15,	14.73	Sept. 11,
Canada Blue (*Poa compressa*), .	July 10,	43.68	Sept. 11,
Water Spear (*Poa aquatica*), .	July 1,	31.97	Sept. 11,
Canary Reed (*Phalaris arundinaria*).	June 25,	23.18	Sept. 11,
Wood Meadow (*Poa nemoralis*), .	July 1,	31.07	Sept. 11,
Creeping Rent (*Agrostis stolonifera*).	July 6,	15.27	Sept. 11,

4. *Millets.*

Twenty-one varieties of millet, occupying one square rod each, were grown for purposes of comparison on medium loam, manured at the rate of 600 pounds of ground bone and 200 pounds of muriate of potash per acre. These were of three species, *Panicum crus galli*, *P. miliaceum* and *P. italicum*. The varieties grown, with particulars concerning amount of seed sown, date of heading, height of plants, and the weight per plot and acre of hay produced, are shown in the table below: —

KINDS.	Ounces Seed Sown.	Date of Heading.	Date When Cut.	Height of Plants (Feet).	Weight, Air Dry, Square Rod (Pounds).	Weight per Acre (Pounds).
Panicum crus galli.						
Japanese barn-yard,	1	Aug. 2,	Aug. 17,	6	65	10,400
Japanese barn-yard, loose headed.	1	Aug. 2,	Aug. 17,	6	63	10,080
Panicum miliaceum.						
Common broom corn,	3	July 19,	Aug. 2,	4	51	8,160
Japanese broom corn, red seed,	3	Aug. 2,	Aug. 21,	4 -6	83	13,280
Japanese broom corn, white seed.	5	Aug. 10,	Aug. 29,	5½-6	92	14,720
California,	4	July 19,	Aug. 2,	4	62	9,920
Chinese,	4	July 23,	Aug. 5,	4	69	11,040
French,	4	July 23,	Aug. 5,	4	66	10,560
White French,	4	July 19,	Aug. 2,	3½-4	65	10,400
Red French,	4	July 19,	Aug. 2,	-	65	10,400
Hog,	4	July 19,	Aug. 2,	3 -3½	63	10,080
Panicum italicum.						
Canary bird seed,	4	Aug. 7,	Aug. 2,	-	40	6,400
Dakota,	4	July 23,	Aug. 12,	3½-4	60	9,600
Early Harvest,	4	July 19,	Aug. 2,	3 -3½	57½	9,340
Golden,	3	Aug. 21,	Sept. 4,	5	100	16,000
Golden Wonder,	4	Aug. 10,	Sept. 4,	5	95	15,200
Japanese Glutenous Hokkaido,	3	Aug. 12,	Aug. 26,	4½	63	10,080
Japanese Glutenous Mukodamashi.	3	-	Sept. 15,	2 -4	100	16,000
Japanese common Millet,	3	Aug. 12,	Aug. 26,	4½	88	14,080
New Siberian,	4	July 23,	Aug. 12,	3 -4	55	8,800

The differences in yield are large, but the sca
which the varieties were grown is small, — too s
my judgment, to justify sweeping conclusions as
relative merits of the several sorts.

The "Dakota" closely resembles the "Early Ha
the "loose-headed" variety of the "barn-yard" r
much less leafy and less valuable than the commo
The so-called "Golden Wonder" cultivated appe
be like the "Golden." The "Japanese Glutenous
"*Mukodamashi*," is very late, and does not matu
us. The variety of glutenous millet from *Hokka*
pears to be a valuable sort. Moisture tests wh
being made will very likely change the relative
of some varieties.

5. *Japanese Millets for Seed.*

A small area of each of our three leading vari
Japanese millets was grown for seed. The soil
tilized for each variety at the following rate per a
fertilizer being sown broadcast and harrowed in : —

Manure,	4	cord
Nitrate of soda,	125	poun
Dried blood,	100	"
Tankage,	200	"
Superphosphate,	250	"
Muriate of potash,	200	"

The season was not very favorable for these crops,
were somewhat injured on several occasions by th
ing of the soil, due to excessive rain-fall.

Barn-yard Variety (*Panicum crus galli*). — T
sown to this variety was .633 acres. The seed w
May 27, in drills, and was cultivated and hand-wee
yielded 1,370 pounds of seed and 4,360 pounds o
which is at the rate of 40 bushels of seed and 3
pounds of straw per acre.

Japanese Broom-corn Millet (*Panicum miliace*
The area of this variety was .248 acres. It was
and cultivated like the preceding variety. The y
535 pounds of seed and 1,620 pounds of straw, wh

e of 40 bushels of seed and 3 tons 532 pounds of
ɔer acre.

ınese Millet (Panicum italicum). — The area of this
was .138 acres. It was planted and managed in all
s like the preceding varieties. The yield was 305
of seed and 519 pounds of straw, which is at the
41 bushels of seed and 1 ton 1,761 pounds of straw
e.

6. Soya Beans.

nall area of each of the three leading varieties of
se soya beans was cultivated for seed. The yield
the following rates per acre: early white, 18.7
; medium black, 16 bushels; medium green, 34.5
. The last-named variety thus once more demon-
its great superiority as a crop-producer over either
ɔther sorts under trial.

7. Clovers.

s were begun in 1895 for the purpose of comparing
our prominent clovers, viz., medium red, mammoth,
and crimson. The result of the first year's test will
ıd in our ninth annual report (pages 27 to 29). As
in that report, our results indicate that the crimson
t prove valuable as a fodder crop in this locality.

ium Red Clover. — The crop of this variety com-
very favorably with that of the mammoth clover in
son of 1896, but during the winter of 1896 and 97
nts of this variety were nearly all killed. The plots
ccordingly ploughed and sown with oats and vetch.

ımoth Clover. — This variety was somewhat injured
winter, but was allowed to stand. Bad weather pre-
its being harvested at the proper time, and it was
damaged before it could be secured. It yielded at
e of about $1\frac{1}{2}$ tons per acre at the first cutting. The
growth was much mixed with weeds. It was cut
eighed green, yielding at the rate of about 2,800
per acre.

ke Clover. — This variety, like the preceding, was
njured by rain. It, like the mammoth, was found to
uffered much during the winter. The crop cut was

much mixed with weeds, yielding at the rate of 2¼
acre for the first cutting. The second growth wa
weeds, and was weighed green, amounting to abou
per acre.

Conclusion. — The mammoth clover under the co
of our experiment has shown greater vitality and pr
capacity than either of the other sorts. It is wort
extensive cultivation.

Sulphate v. Muriate of Potash for Clovers. — A
in our ninth annual report, there were two plots of
the varieties of clover under comparison, one fertili
muriate of potash, the other with sulphate of potas
results in 1896 showed no material difference in yiel
could certainly be ascribed to the nature of the pot
used. The same is true this year.

The sulphate plots, both of the mammoth and th
clovers, yielded most at the first cutting; the muria
in both cases, yielded most at the second cutting;
stated, the crops secured at the second cutting were
mixed with weeds. The results, therefore, must be r
as without especial significance.

8. *Sweet Clover* (*Melilotus alba*).

This crop occupied two plots of two-fifteenths of
each, in Field B. The same crop was grown upo
plots in 1896, and the results are fully discussed
ninth annual report. The growth during that sea
for the most part small and unsatisfactory, owing ap
to the fact that the appropriate nodular bacteria w
present in sufficient numbers to enable the crop to m
of free atmospheric nitrogen. A few of the plants
were found to have abundant nodules upon thei
These showed a deep-green color and made a v
growth. It was judged that, if the land should b
oughly worked in various directions, the nodular
would be scattered throughout the soil, and that th
crop upon the same land would be better than the fir
soil was accordingly thoroughly prepared, and the
the crop of this year sown at the rate of 10 pounds
on July 30, 1896.

ie growth was very much superior to that of the pre- ; year, and upon examination in the early part of the n it was found that the roots of about one-half the s were abundantly supplied with nodules. These plants making a vigorous growth, and had a deep-green color, ative of an abundant supply of nitrogen. They were is time evidently able to draw upon the atmosphere for element. Later the other plants in the field seemed to gain this ability.

July 8 the crop averaged 6 feet in height. A portion ut and fed to the cows kept in the department of foods eeding. This portion yielded at the rate of about 12½ per acre. Dr. Lindsey reports that the cows ate it ly and appeared to be fond of it. It was, however, r coarse for feeding when allowed to stand until the part of July. If to be fed, the crop should be cut . In average seasons it would be at its best condition g the first half of the month of July. It is not, how- as a fodder crop that I am inclined to recommend a of sweet clover, but rather as a crop for green manur- I believe it may serve here a similar purpose to that d by crimson clover in localities where it is hardy.

Miscellaneous Crops.

falfa. — One-quarter of an acre of light soil was sown .pril 17 with alfalfa. The fertilizer applied to the er acre was as follows: fine-ground bone, 100 pounds; te of soda, 50 pounds; phosphatic slag, 50 pounds; ate of potash, 50 pounds. One-half the seed used was ed with nitragin. All the seed germinated quickly, no ence being noticed between the treated and the un- ed. The small plants were, however, injured by the rains, and up to date the crop has made but a feeble th.

ccaline. — Our trial of this crop has been carried out two small plots, the one having a heavy, moist soil, ther a light, drier soil. One-year-old plants were set e spring of 1896. The growth during that season was e. In August of that year each plot was given a good

dressing of manure. In the spring of 1897 it w
that a considerable number of the plants had been
killed. On the heavy soil 36 out of 408, and on th
soil 71 out of 129, were dead; of 451 plants left in a
258 were dead. Plants which lived through the wi
well started by April 20, but the new growth was
a frost. On July 16 the growth, which ranged fro
feet in height, the average being about 3 feet,
The plants were large and woody. The yield on t
soil, 408 plants, was 295 pounds; on the lighter
plants, 132 pounds. The leaves only were eaten
—horses would not eat it at all. A second crop
cut, but on October 1, when the plants were killed
the second growth averaged about 18 inches in hei
a result of our trial of this crop, I am convinced
without value as a fodder crop for us.

Crimson Clover.—A further trial of this crop
made upon a rather light soil. The seed was sow
with equal parts of winter rye. Nitragin, not re
season to apply with the seed, was mixed with w
cording to directions, and applied to the clover A
the plants then standing about 2 inches high.
was a complete failure, every plant being winter-ki

Winter Vetch.—A small plot of this crop has be
upon a light soil. It was sown August 20, equal
vetch and rye. This vetch proved perfectly hardy
vigorously, reaching a greater height than the ry
vetch will prove valuable as a green fodder when s
winter rye.

Besides the above, we have cultivated a few rows
a large variety of fodder plants, some 39 in num
this variety are included a large number that h
mentioned in previous reports, and they do not
further notice at this time.

Among those cultivated for the first time this yea
Idaho field or coffee pea (*Cicer arietinum*). This
to be the same as the gram or chick pea, which we
under cultivation for two years. The growth is t
to make it valuable for a fodder crop.

ɔther new fodder crop for this year was the *Brazilian ıg flour corn.* The plants made a vigorous growth, ɾe judged to be too coarse and woody to prove of value fur fodder.

ck chaff or African millet is another crop under trial ear for the first time. It appears to be the same as corn, and, as reported last year, our experience leads us ɪrd this fodder crop as inferior to maize for our climate.

A Reputed Method for Destroying Stumps.

orrespondent in one of our agricultural papers during ımmer of 1895 reported that he had found it possible troy stumps in the following manner: —

ole one or two inches in diameter according to the f the tree, and eighteen inches deep, is to be bored in ump. Into this put from one and one-half to two ; of saltpetre, fill with water and plug tightly. Six s later, put into the same hole about one gill of kero-ɔil, and set fire to it. The correspondent stated: stump will smoulder away without blazing, even down ry part of the roots, leaving nothing but ashes."

Nov. 4, 1895, fifty stumps of trees cut in 1894, in-g the following varieties, maple, hickory, hemlock, pine, yellow birch and elm, were bored according ections. On December 11 saltpetre and water were to the holes, according to directions, and the holes ɛd. During July, 1896, the plugs were removed, the were filled with kerosene, and an attempt made to he stumps. It was found that not even the oil would A portion of the stumps were left until June, 1897, another attempt was made to burn them, using a low-il, called paraffine gas oil. The stumps are still in ld. The method has been given a thorough trial, but ɔe regarded as a complete failure.

Poultry Experiments.

ɔeriments with poultry were carried out during the : of 1896 and 1897. Our attention was confined to points: —

1. Effect upon egg-production of the use of co
powders.

2. Comparative value for egg-production of dry-
animal meal and cut fresh bone.

3. Comparative value for egg-production of cut
and fresh cabbage.

General Conditions.

In all of these experiments pullets purchased in Pl
County and sent to us in December were used. A
laid before we received them, and production was
by the move, as is generally the case. Some of the
moulted after reception here, which served to red
egg yield. Each of the six lots of fowls occupied a
with roosting and laying room ten by twelve fe
scratching shed eight by twelve feet in size. Each
liberty of a large yard, which furnished a little gra
April 15, but in all alike. Each of the feeding trial
January 1 and continued until May 2, — 122 days.

Soft foods were mixed for the morning mash with
water the night before using. Sufficient of the m
for a fortnight were mixed dry at one time. Oa
always scattered in the straw in the shed at noo
night the wheat was fed in the same manner. As a
little cut bone was fed once a week, in place of th
ration of oats. About twice a week cabbage was h
in each coop except the one where cut clover wa
comparison with this vegetable. Clear water, she
grit were before the fowls all the time. Occasiona
was added to the morning mash. At the conclusion
experiment the dressed fowls were sent to G. M. A
Son, Boston, who reported upon the quality of the
lots.

1. Effect of Condition Powder upon Egg-produ

This experiment was carried out in most respect
same manner as last year. Light Brahmas were
for this test, 20 in the coop receiving condition p
and 19 in the other. The food of the two lots was th

d, with the exception that the fowls in House No. 6
d daily condition powder in the morning mash, in
ance with directions furnished with the powder.
kinds and amounts of food used are shown in the
—

KINDS.	Amounts (Pounds).	
	No Condition Powder.	Condition Powder.
. . . .	209	220
. . . .	150	150
. . . .	27	28
gs, ...	27	28
meal, ...	27	28
. . . .	27	28
e, ...	28	29
al, ...	28	29¼
. . . .	9	9

ut three pounds of condition powders were used in
periment.
weights of the fowls were taken at intervals, and
s follows: —

Average Weights (Pounds).

	No Condition Powder.	Condition Powder.
4, ...	4.868	4.650
y 4, ...	5.260	4.950
), ...	5.360	5.343
, ...	5.310	5.470
(after fasting twelve hours), . .	5.160	5.180
l weight, ...	4.605	4.657

The results and leading details are shown below:-

Condition Powder for Egg-production.

Experiment January 1 to May 2.	Number of Hen Days.	Gross Cost of Food.	Cost per Hen Day.	Cost of Food per Egg.	Number of Eggs.	Weight of Eggs.	
						lbs.	oz.
No condition powder,	2,318	$6 61	$0 00285	$0 0124	532	65	1½
Condition powder, .	2,354	6 68	00280	0125	540	67	4

The nutritive ratio was 1 : 5.16 for the fowls not
ing condition powder; for the others, 1 : 5.14,—pra
identical. The total dry matter in food consumed fo
egg produced was: without condition powder,
pounds; with powder, 0.8688 pounds. Besides the
eggs as shown in above table, the fowls receiving n
dition powders laid three soft-shelled eggs; the other
There were five sitters in the first lot, eleven in the s

Samples of the eggs were analyzed, and those fr
condition-powder fowls were found somewhat richer
matter, protein and fat. The eggs were also tested
families by careful house-keepers. The reports d
agree in all particulars; but one of the two found th
from the fowls which had received condition powde
perior in flavor of yolk, flavor of white, in beating q
and in consistency; the eggs from the other fowls b
color and size of yolks. The other reported the con
powder eggs strong in flavor and the yolks small.
discrepancy is probably to be accounted for from t
that the number tested was small. Individual as
class differences would almost certainly be found
eggs.

The fowls which had received condition powder w
ported as dressing rather better than the other lot.

One fowl in the condition-powder house died duri
test; there were no losses in the other house.

In conclusion, I have to say that the differences fo
this experiment are too small to be considered decisiv
the side of the condition powder we have size of eg

ht and quality of the dressed fowls; against the powder, ave the food cost per egg, the weight of dry matter in per egg, and the loss of one fowl. We are warranted ly in the statement that the powder does not appear to paid for its use.

2. *Cut Bone v. Animal Meal for Egg-production.*

ch of the two houses contained twenty Plymouth Rock ts in this experiment. The bone and animal meal were mixed in the morning mash. The foods used are n below: —

KINDS.	Cut-bone House (Pounds).	Animal-meal House (Pounds).
t, ...	213	196
. . . .	149	149
. . . .	27	28
ings, ...	27	28
lo gluten.	–	28
al meal, ...	–	28
r, ...	28	27
ages, ...	26½	29⅛
go gluten, ...	27	–
one, ...	28	–

ne nutritive ratios in the two houses were 1 : 5.05 and .45 respectively.

ne average weights of the fowls were as follows: —

	Cut-bone House (Pounds).	Animal-meal House (Pounds).
ary 4, ...	4.75	4.89
uary 6, ...	5.10	5.00
h 9, ...	5.86	5.28
27, ...	5.44	5.15
3 (after fasting twelve hours), . .	5.28	4.88
sed weight, ...	4.83	4.43

The dressed fowls which had received the cut bo
reported slightly better than the other lot. The
details and results are shown in the following tabl

Cut Bone v. Animal Meal.

EXPERIMENT JANUARY 1 TO MAY 2.	Number Hen Days.	Gross Cost of Food.	Cost per Hen Day.	Cost of Food per Egg.	Number of Eggs.	Weight of Eggs.	
						lbs.	oz.
Cut-bone house, .	2,279	$6 61	$0 0028	$0 0130	508	64	9
Animal-meal house, .	2,440	6 24	0025	0097	639	80	15

There was, in addition to the eggs as shown by th
one soft-shelled egg in each house. Two hens in
bone house died during the experiment, from di
those in the other house were healthy through
experiment.

The dry matter per egg was, where cut bone
0.877 pounds; on animal meal, 0.69 pounds. The
of sitters was 6 in the cut-bone house, 12 in the oth

A sample of eggs from each house was subjected t
sis. Those produced on the cut bone contained rath
protein but less fat than the other. A test for
quality was indecisive; one of the two house-keeper
preferred one lot; the other the opposite lot.

The advantage in this trial is, then, clearly with
mal meal as a food for egg-production. It has give
eggs of a greater average weight and at considera
cost than the bone; and it is, moreover, a more co
food to use, as well as safer. The results this year
the opposite of those of last year. We have now
this experiment four times, with results twice favo
the bone and twice to the animal meal, but have no
found so decisive a difference as this year. We re
experiment again this winter.

3. Clover Rowen v. Cabbage for Egg-product

Plymouth Rock pullets were used in this expe
but they were later-hatched fowls than those in the
ments already described. There were twenty fowls

two houses, at the beginning. One fowl died in each during the experiment, from unknown causes. The ver was fed in the morning mash. Instead of the a fresh cabbage was kept before the fowls in the house.

foods used are shown in the table : —

KIND.	Clover House (Pounds).	Cabbage House (Pounds).
. . . .	223	212
. . . .	150	149½
. . . .	28	36
gs, ...	28	36
meal, ...	28	34¾
. . . .	26	-
e, ...	-	46¾
e, ...	8½	8½
l, ...	28	36

nutritive ratio was practically the same in both : viz., in the clover house, 1 : 4.99 ; in the other, 38.

average weights of the fowls were as follows : —

DATES.	Clover House (Pounds).	Cabbage House (Pounds).
4, ...	4.560	4.530
y 4, ...	5.480	4.800
, ...	5.420	5.350
, ...	5.470	5.394
(after twelve hours fasting), . .	5.289	5.184
weights, ...	4.780	4.890

The leading results and details are shown in the t

Clover Rowen v. Cabbage for Egg-production.

Experiment January 1 to May 2.	Number of Hen Days.	Gross Cost of Food.	Cost per Hen Day.	Cost of Food per Egg.	Number of Eggs.	Weight Eggs.	
						lbs.	o
Clover house, . .	2,356	$7 033	$0 0029	$0 0150	466	59	10
Cabbage house, . .	2,423	6 988	0028	0118	588	75	1

In addition to these, the fowls in each house laid
shelled egg.

The advantage lies most decidedly with the f
cabbages, in so far as numbers, weight and cost of
concerned. The eggs from the clover house were, h
much superior in cooking and eating quality to th
the other. Both house-keepers reporting are most e
in the expression of their preference for the eggs f
fowls fed the clover. One reports: "The eggs f
clover lot are in every way superior." The oth
"They are superior in color, size of yolk and flavo
adds that "they have the finest flavor of any eggs"
ate.

Analysis showed the eggs from the fowls fed cab
contain higher percentages of dry matter, protein
than the others. The superior richness of these e
parently renders them strong in flavor.

REPORT OF THE METEOROLOGIST.

JOHN E. OSTRANDER.

e work of the meteorological department during the year has been in the main a continuation of that of ous years, with such minor changes as, after due con-ation, have seemed advisable. The observations for erature are now all taken in the ground shelter on the us. The publication of the maximum and minimum eratures taken in the observatory shelter was discon-d last year, owing to their unreliable character. For ame reason, the observations themselves were discon-d early in April the present year.

e usual bulletins, giving a summary of the records and er for each month, have been published. An annual ary will be issued as soon as the records for the year ompleted.

material additions have been made to the equipment e department during the year.

rangements have been made to furnish the New Eng- Weather Bureau with the weekly snow reports, as was last year.

co-operation with Professor Whitney of the Division oils, United States Department of Agriculture, this tment installed one of his instruments (kindly loaned e Department at Washington) for the electrical deter-tion of moisture in the soil. Observations were taken the latter part of June until early in November. The ds, however, are incomplete for the period, owing to s in the circuit and other causes which made the in-ents fail to work at times. The readings taken were weekly to the Department at Washington. The Di- n of Foods and Feeding of this station made some

independent determinations of moisture for stan
the instrument, and the Division of Botany kept
of the growth of the crops where the electrodes wer
Owing to the unusually wet weather during the sun
the incomplete records of the instrument, the resu
experiment were not entirely satisfactory. The de
expects to repeat the observations next year un
favorable conditions, and an outfit for that purpose
ordered.

It is hoped that arrangements may be made to
electrometer in the tower in working order, so that
tions on atmospheric electricity may be undertaken

REPORT OF THE BOTANISTS.

GEORGE E. STONE, RALPH E. SMITH.

r work during the past year has been in general a con-
tion of that of the year preceding. In this, as in other
tments of the station, the work falls under two classes:
examination of material sent in for determination and
ering of inquiries; second, investigations of problems
ected with plant physiology and pathology.

r the purpose of investigation the greenhouse has been
delled and enlarged during the past summer, so as to
of carrying on experiments under more desirable con-
ns. It is quite essential, in experimenting with plants,
he number employed should be large enough to make
ssible to draw deductions from the results with a rea-
le degree of certainty that errors arising from indi-
l variation have been counterbalanced. It is also
tial that the heat, light and moisture conditions should
ual upon each series of plants under consideration, and
these conditions should compare as closely as possible
the best method of cultivation. In the construction of
xperiment house these details have been considered as
ully as possible. The house as now arranged consists
veral sections, in which different temperatures can be
tained, for growing tomatoes, cucumbers, lettuce and
important plants subject to destructive diseases. The
nt of money invested in the production of greenhouse
is large and continually increasing, and no small part
r work consists in the study of the various diseases
h affect them.

r the last three years we have been investigating meth-
of controlling the gall-forming nematode worm, which
s cucumbers, tomatoes, English violets, roses, cyclam-

ens and many other greenhouse plants. The result investigation are nearly ready for publication, but i desirable to first clear up a few remaining points u habits of the worm, which are not well known.

Experiments are also being made upon the differe ods of pruning tomatoes, and upon the best light co for assimilation in greenhouse cucumbers.

With regard to lettuce we are studying the me conditions of the soil as affecting the crop, and the fungous diseases to which it is subject, more especi disease known as the "drop."

In addition to these experiments, it may be me that there are incidentally being carried on invest upon the influence of electrical currents on the gr plants. Bulletin 43 of this station embodied the mo ful and extensive series of experiments ever made u subject. They were carried out by Mr. Asa S. while a student at the college, and did not necess under station work. The results obtained by him such a promising nature that it has seemed well w time to carry the investigation further. It should b that any costly method of using electricity as an acc of plant development is not to be recommended. ever, any simple and cheap means of using electric can be used, which will give an acceleration in the of a crop equal to 30–40 per cent., it might be w consideration by practical agriculturists.

We have in progress a series of experiments with gaseous substances, with a view to developing a tr of this sort for combating fungous diseases of gre plants. This method of treatment has been sugg the extensive application which it has reached in nating insects. While we are as yet unable to pre results of great practical value, it is hoped that t periments may lead to the development of an effecti ment for greenhouse plant diseases by the use of a substance. The great superiority of such method o of spraying, which is in many cases inapplicable, exposition. Our experiments thus far have been ca

gases, hydrocyanic and formaldehyde. Neither appears to answer the purpose. The former, which found to be of considerable value as an insecticide, e made effective as a fungicide without using a which will prove fatal to the plant. This we have ed by parallel exposures of various fungous spores s to the gas, and also by the fact that spores of the rust, taken from plants which had been almost over-exposure, germinated freely. Formaldehyde l-marked fungicidal effect, and is much less harm-ants; but we cannot at present recommend it as a ungicide, on account of the difficulty of producing cient strength.

st year has been an exceedingly abnormal one for n, and as a result this division has had many in-oncerning plant diseases, different from those of years. The excessive and long-protracted rains ack of sunshine gave rise to a multiplicity of plant such as we have not had for some years. This was not only in regard to our various crop plants, but duced ornamental species and even our wild plants usually affected by fungi. An unusual number of lled spot diseases made their appearance, and de-o a greater or less extent more than one species of hese spot diseases were especially disastrous to the and butternut, both of which in many instances heir foliage; while other trees, such as the chest-vild cherry, were more or less affected. The fungi these diseases are not new to these trees in this but the abnormal conditions to which all vegetation ected proved amply sufficient to accelerate their nd development.

ver the normal conditions surrounding the plant rbed, we must expect to find irregularities in its ; and any serious irregularities in the plant's func-most likely to manifest themselves by the presence insect, fungous or bacterial organism. Abnormal , or, in other words, physiological disorders, are rity of instances the basis of many plant diseases

with which gardeners have to contend; and, since liable to observe only the effects of the fungus or preying upon the plant, we too often think that they primary causes of the disease, when, as a matter they are purely secondary.

This leads us to the subject of spraying as a pr of plant diseases. From the hap-hazard manner it is often resorted to, one would gain the idea that tended as a curative rather than as a preventive This idea is erroneous, inasmuch as spraying is int a prevention rather than a cure. This misconcepti proper use of spraying solutions gives rise to the of using the Bordeaux mixture as a panacea for eve disease. Upon this point we wish to state that it distinctly borne in mind that spraying under any c is only a temporary means of preventing certain The ultimate aim of all progress connected with g should be not only to improve the marketable pro to improve the stock and increase our knowledge p to proper cultivation, so that spraying will be unne Many experienced gardeners recognize this, and experts in almost every line of gardening who h eminent success in controlling diseases without res the use of fungicides. Some of the most exp growers of carnations claim that they can control t diseases which have of late years affected this p simple, judicious methods in the management of th house.

To expect that spraying is going to save plants improperly cared for, or to act as a cure for those diseased, is absurd. There are many instances whe ing produces beneficial results, and at the presen appears to be essential, in some instances, to the pr of good crops; but there are also many instances is entirely useless. This applies especially to the having their origin in improper care or in abnorm tions surrounding the plant. The condition of t crop in Massachusetts during the past summer a illustration of how any amount of spraying would

disease, when the soil was soaked with water and s in some instances practically submerged for days e. Every plant is surrounded by a host of para- anisms, which, given the proper conditions, will their distinctive properties. The healthy, vigor- t is always less susceptible to the attacks of fungi weakly, abnormally developed one, — a fact which ractical gardener readily understands. We have s illustrated so many times in our work in the use that it may be well to give an example of it ertain species of non-parasitic nematode worms, e always present in greenhouse soil, although appar- ing no harm as long as the plants are vigorous, soon as the plant becomes weakened or abnormal cause, penetrate the tissues and cause rapid decom- of the same. What is true in regard to nematodes lso to fungi and bacteria, and, indeed, these various organisms are most frequently to be found together cayed tissues of the plant.

any attempt is made to spray diseased plants, it is th while to find out something about the nature of se with which the plants are affected. It is, for unwise to spray roses for the black spot or mil- n the roots are half decayed by the action of para- -forming nematode worms; and for the same reason be unwise to treat the spot disease of the English hen the roots are covered with hundreds of minute d when the supply of nutriment from the root is nterfered with.

e other hand, spraying the apple, grape, potato and at the present time justifiable and necessary; and many diseases common to greenhouse cucumbers toes which can be largely controlled by spraying, it must be said here that by judicious management rious conditions surrounding the plants these dis- n be checked.

THE CAUSES OF THE FAILURE OF THE POTATO C
1897.

The disastrous effect upon agricultural crops of th
sive rainfall of the past season has been especially
upon the potato. The small yield and large amoun
ting of this staple may be easily attributed to this
In all sections of the State, as well as beyond our
the report has been general of a small potato crop
cessive rotting. This rotting has been generally
as resulting from the well-known and ordinary
rot" fungus, Phytophthora infestans. In fact, how
have to describe a series and variety of agents
under the favorable influence of the excessive ra
an influence unfavorable to the vitality of the plant
brought about the diminution and destruction of the

At planting time the ground was extremely w
crop, however, started well, and the plants appear
ground in a promising manner. Continuous rains
soil saturated with moisture, and before the pl
reached a height of more than six inches it was n
many places — usually the lowest and wettest por
the field — that many of them were dying. Such p
not collapse suddenly, but gradually turned yellow a
away, most of them dying eventually, though here a
one would be seen which maintained a feeble, stunte
through the season. This was the case not only
vicinity, but it was also reported from various part
State.

Investigation of affected plants showed that the
was due to a rotting of the stem of the young plan
ground, which rotting evidently proceeded from
potato, which was found in every case to be a putr
while the decay was gradually extending up the you
Careful search for the cause of the rotting failed
any particular organism to which it could be ascribe
it was of bacterial origin seemed quite certain, as
cayed tissue swarmed with organisms of this class,
fungus which could be considered the cause of the

was found. In the cortex and exterior portions of decayed stems several forms of Micrococcus and also other bacteria were found in abundance. In the interior portions a large, motionless bacillus occurred quite abundantly and exclusively, and may have been the primary cause of the rotting. The most probable explanation, however, seems to be that the normal functions of the plant were disturbed and its growth checked by the unusual amount of moisture in the soil. The seed potato, with its supply of reserve food material for the young plant thus left idle in the soil, naturally rotted away, and this rotting communicated itself more or less to the young stem proceeding from the "seed." The plant, not being in a condition of vigorous growth to resist this rotting, gradually succumbed to it, and in most cases died. The few plants, as mentioned above, which continued a feeble growth through the season, accomplished this by throwing out roots above the rotted portion of the stem, and thus prolonged a feeble existence. Such plants produced no tubers, and consequently had no value whatever.

This, then, was the first of the troubles affecting the potato crop in this section. We do not describe or consider it as a specific "disease" of the potato, nor do we deem it necessary to consider any treatment for it. We at first recommended removing affected plants, but doubt now if such a course would have been of any considerable practical value. We are inclined to believe that the trouble was not brought about by any specific or especially destructive organism, but was simply the result of the unusual meteorological conditions of the season, and under such conditions could not be prevented from occurring by any means at our command.

By July 1, most of the plants which had fallen a prey to the above disease were withered away and dead, while those which had escaped had made a fairly good growth and nearly reached maturity in point of size. About July 15 several hot, sunny days came on, following a long very rainy spell. In many potato fields on low ground the plants began to wilt and die down. In a large field at the college, situated on a long slope, the plants at the top were un-

affected, but those in a limited area at the botto
slope — the wettest part of the field — began to
plate). Many had already died here from the effe
first disease. It is a well-known fact that plants
when exposed to strong sunlight after a continue
and wet period, this being due to excessive ev
or transpiration of water from the leaves. In t
however, the wilting was too pronounced to be a
to this simple physiological phenomenon. Inve
showed that the leaves were not "blighted" nor
affected in any way except the simple wilting, w
evidently caused by some trouble at the root. Pl
then dug in various portions of the affected area,
stages of collapse, and their roots examined for the
the trouble. It was found that there was no one
(except possibly bacteria) attacking the plant,
was a general rotting, resulting from the wet con
the soil and consequent low vitality of the pla
features of this rotting varied greatly in differen
however, and scarcely any two were affected in a
similar manner, it being almost impossible to
feature of the disease common to all, except the w
the tops. In the very wettest part of the affe
the tubers were rotting badly. These rotten tu
swarming with bacteria, but they were of vario
and to no one could be ascribed the beginnin
trouble. Various species of fungi were found in
these were moulds and similar forms, and include
which by any probability could have caused the
Since fungi were entirely absent in many of t
tubers, it is certain that they did not cause the tro
many cases the decay seemed to have started whe
of some kind had eaten into the potato. On
dryer ground, where the plants wilted, the tubers
rotten. In many cases, however, the stem was fo
decayed just where it joins the root. The young
were also rotting, so that the cortex fell away
central portion. These symptoms also occurred,
pronouncedly, in cases where the tubers were ro

decayed stems and roots no one organism could be l as the cause of the rotting. Bacteria (mostly micro-s) swarmed in all affected parts, and several mould also occurred. Quite noticeable on all affected plants he occurrence on tubers and even on the base of the of small, white, mealy dots, scattered abundantly the surface. These were apparently enlarged lenticels, composed of parenchymal cells breaking out at the ce. It seems probable, or is at least possible, that their iction was due to the scarcity of air in the wet soil.

e can only conclude here, as in the other case, that this ot be called a definite disease, but rather was the result normal and unusual conditions. During the long-con-d rain the living functions of the plant were disturbed ts growth checked. Various organisms then came in, gaining a foothold, so weakened it that when the sun out it wilted down and in the worst cases died. Had en possible to thoroughly cultivate and stir the soil is time, it is reasonable to suppose that much of the le might have been averted; but the extreme wetness such a course impossible.

is trouble came on after the potatoes had reached a etable size. We therefore recommended digging them affected places, in order to save them from decay. Be-this there could be no practical treatment suggested.

rly in August, or even sooner, the real potato blight t, Phytophthora infestans, began to appear, and devel-very extensively during the month, killing the tops of oes everywhere, and causing great loss by rotting of ubers. This disease is too well known to need ex-d description. Its ravages might probably have been olled to some extent by thorough spraying throughout eason, but it would have been practically impossible to ly prevent it in such a summer.

The "Drop" of Lettuce.

e loss represented by this disease frequently amounts ousands of dollars in a single season in Massachusetts. st every lettuce grower has had more or less experi-

ence with it, although, as with every other dis
have been much more affected than others.
known several instances during the season wher
growers have lost practically their whole crop
consequence, have become much discouraged w
growing. Inasmuch as the general characterist
disease were given in the ninth annual report, it
essary to enter upon any minute description her
it to say that the disease makes its appearance i
close to the surface of the ground, where the tiss
slimy and soft, and eventually the whole stem a
disintegrates and collapses. This occurs most
just as the plants reach maturity.

The fungus causing this disease is well known t
house men. The "damping fungus" (Botryt
causes the drop, often gives rise to disastrous
begonia and other cuttings in the propagating
fungus, however, as it appears upon the lettuc
some aspects which are different from its appea
cuttings, and reaches a more advanced stage
ment. Our present knowledge in this directio
more of a technical than practical interest, alth
derstanding of the complete life history of the f
no doubt, lend much aid to its rational treatment

The natural conditions governing the develop
organism appear to be similar to those of most
— that is, it requires the presence of oxygen.
known that almost any object when driven into
will undergo disintegration much more rapidly
face of the soil, for here the conditions of mo
are most favorable for the organisms producing
tion. And so it is with the "drop" fungus; i
the conditions at the surface of the soil, unde
shady leaves of the mature lettuce plants, for its
work.

Our experiments upon the control of this fu
no means complete, but it will not be out of p
offer some suggestions in regard to its general
the methods of treatment which may be tried.

grower has the germs of the disease in his lettuce soil
eater or less extent, but the conditions giving rise to
xcessive development are not always present. Some
hat manure is the principal source of infection; yet,
other hand, while all use manure, all are not troubled
same degree. As a remedy for the drop, some have
d to the practice of sanding the surface of the soil or
on a layer of yellow loam. This is for the purpose
ng a clean, uninfested surface to the soil surrounding
nts. In regard to the effect of this treatment, it may
ted that opinions differ considerably. Whether the
l of applying a superficial layer of sand or subsoil to
face will be of any assistance in keeping the drop in
ppears somewhat doubtful, from an experiment made
ing some infested plants to a depth of three or four
in a pot of yellow loam subsoil. It was found that
gus made its way to the top in a very few days, as
ident from the mould-like growth of the mycelium
he surface of the soil and the death by drop of plants
had been set in the pot. Neither can we expect much
he application of chemicals, as any such treatment
interfere with the growth of the plant, and hence
objectionable. Some experiments are now being
with gases, with the idea of killing the organism
nigation; but this method does not promise much
.

application of live steam to the soil, and thus steril-
t, would undoubtedly destroy the germs of the dis-
To do this would necessitate laying two-inch tile at
of eight inches or a foot below the surface of the
nd at a distance of one or two feet apart, and driving
m under pressure and allowing the same to permeate
l. This method can be employed on a small scale
ood results, but the larger area of a lettuce house
render its practical application uncertain. Another
l of treatment by steam, which would be far cheaper,
be to sterilize the surface of the soil to a depth of
or four inches or more. This can be done by con-
ng a pit in the lettuce house and covering the bottom

with tile or one and one-half or two inch stean
The tile allows the steam to escape very readily
order to get the best effect, they should be laid
gether, say one foot, or less. In case steam p
used, — and they are probably more effective thar
they should be bored with holes every three or fou
to allow the steam to escape. With an arrangemen
kind, one would be able to sterilize the soil in a fe
A pit twenty feet long, ten feet wide and eightee
deep would hold sufficient soil to cover twelve
square feet of surface three inches deep. The time
to heat this earth up to 200° F. would be only a fe
Of course the pressure of steam available, the clos
the pipes and the number of outlets for the stea
largely determine the time necessary to heat the ea

Various methods of treatment for this disease a
tried, to determine how it may be most effectua
with. In connection with the method of steam ster
which seems by far the most promising, it is espe
sirable to ascertain just how deep the soil must be
in order to keep down the fungus.

The Asparagus Rust.

(*Puccinia asparagi.* D. C.)

In the last annual report of this division atten
called to a new disease which had appeared upon th
agus, and the apprehension expressed that it might
be a serious matter. That apprehension has been m
justified. The asparagus rust, unknown to the gr
Massachusetts in 1895, slightly prevalent in 1896,
peared everywhere during the past season, and bid
become a most important factor in the growing of t

The disease first appeared in the fall of 1896, bot
State and in several others, but was not generally p
at that time, although in some fields it was very a
Cutting and burning infested tops was generally
mended and to some extent practiced; but the ma
asparagus growers had not as yet become acquain
this new danger menacing their crops.

'his rust, like the well-known one of the wheat, has three erent stages or forms in its development, though in this they are all developed upon the asparagus plant, while he other, one form comes upon the barberry bush and other two upon the wheat and other grains and grasses. en first noticed in 1896, the asparagus rust was in the stage, the black rust or *teleuto* stage, the earlier stages having attracted attention. In 1897 many asparagus ls were found to be affected as early as July 1, and by ust the complaint was general throughout the asparagus-ving sections of the State. It was now the red rust, or *lo* form, which was present, being followed again in the by the black form. Apparently almost every field of ragus in the State was affected before the end of the on. The rust in most cases appeared first on young s, — which was natural to expect, since the stalks were being continually cut off as they appeared. In the older s, from which the stalks were being cut for market, little io rust appeared until well into July or August, after ing had been suspended and the tops allowed to develop. nost cases, however, they were soon affected as badly as . The effect of the rusting was that the tops lost their n color, and turned brown and died prematurely. Mr. rge P. Davis of Bedford says in regard to his beds: he twenty-sixth of July the tops were all turned brown, looked as though a fire had swept over the field. There no green to be seen. . . . In handling the tops a fine which looked like smoke was quite noticeable." This consisted of countless numbers of the spores of the gus.

he first attempts at checking the rust were made in the of 1896, and consisted of cutting and burning affected . When the disease appeared so extensively in 1897, y growers cut the tops in August, when they had ome badly rusted. It is impossible to say with much ainty what the result of the first cutting (fall of 1896) have been, inasmuch as comparatively few beds were treated or badly affected at that time. A good-sized at the college was considerably rusted, and the tops

were cut and burned late in the fall. The bed w
cultivated and fertilized, and no rust appeared upo
1897 (that is, not enough to be noticeable) until w
the fall, when the black rust stage was quite as abun
it had been in 1896. Mr. S. T. Davis of Orleans al
tions having observed a small bed, which was cut in
of 1896, upon which no rust appeared in 1897. W
the cutting of the tops or some other factor kept d
rust in these beds, we are not prepared to say. The
which was quite extensively practiced in the summer
seems to have been entirely without effect, as the
peared again just as badly on the second growth.

The experience of another season is necessary to
strate the actual effect and seriousness of this disea
perennial occurrence to the extent of the past seaso
not fail to have a disastrous effect upon the asparagu
ing industry. It is not the sort of disease which i
ually suppressed by spraying methods, though so
of that sort may be developed if it becomes necessar
should be remembered, however, that the past sea
an unusually favorable one for all fungous diseas
consequently it may have developed much more ext
than it ordinarily would. If it could be mostly con
its teleuto or black rust stage, which appears in
when the plants have practically completed their gr
is not probable that any serious injury would resu
all events, the effect of the great prevalence of the
1897 upon the asparagus crop of 1898 will be awai
great interest by all interested in its cultivation.

The Fire Blight.

(*Micrococcus amylovirus.*)

This disease of the pear, quince, apple and othe
ceous trees has been the subject of frequent inquiry
the past season. It ordinarily causes the most damag
pear and quince, and is one of the most destructive

* Recent experiments indicate some amenability of the rust to sprayin
not more than twenty-five per cent. reduction is claimed.

ases. The trouble appears in the branches, sometimes hole limb of considerable size, but more often the smaller inal twigs, being affected. These portions of the tree lenly wilt and die, the leaves and young fruit turning k and hanging to the branches, producing the character- scorched appearance which gives the disease its name. preads rapidly about an orchard and increases from year ear, often involving the entire tree and causing its death ft unrestricted.

he cause of this trouble was long a matter of specula- , but it is now known to be a species of bacteria which s access to the tissues of the tree and by its rapid iplication therein causes great destruction. This dis- cannot be reached by spraying, and the only remedy ists in severely cutting back all affected branches, or le trees if badly affected. All such prunings should be destroyed by burning. This cutting should be done never the disease is observed, but is especially advisable e fall or late summer, when the trees should be care- examined, to make sure that no diseased branches or s are left to perpetuate the disease over winter. As disease affects the hawthorne (Cratægus), shad bush elanchier) and mountain ash (Pirus Americana), as as the cultivated fruits, it may spread from some of wild trees to the latter, unless care is taken to prevent contagion. It is not probable, however, that such in- on is ordinarily at all extensive.

The Quince Rust.

(*Gymnosporangium clavipes* C. and P.)

e numerous inquiries which we have received during past season concerning this not uncommon trouble, as as our own observations, indicate that it has been un- lly prevalent and destructive. The disease affects prin- lly the fruit, but also the young wood, causing distortion malformation in both cases. It is very conspicuous the affected quinces in midsummer, both from their rted shape, and from the numerous white, tubular ex- cences appearing upon their surface. These excres-

cences contain masses of the bright orange-yellow c spores of the fungus which causes the disease. The has a peculiar course of development. It not only ex the form seen upon the quince, but has also another f stage, living upon a different kind of plant and quite ent in appearance. This stage of the fungus lives up red and white cedar and the juniper, and is one of the which produce upon those plants the abnormal growth ularly known as "cedar apples." These cedar app peculiar outgrowths upon the twigs of cedars and ju reaching their complete development in early spring. are oftentimes regarded as the proper product of the as insect galls, — which ideas are equally incorrect. growths begin to form in midsummer, developing a excrescences upon the twigs and gradually increas size until winter, when they are nearly full grown "apple" consists at this stage of an abnormal mass cells of the tree, with the filaments of the fungus g abundantly between them. Remaining thus over the first warm, moist weather of spring starts it into growth and development. Upon the surface of the wood numerous projections appear, of a conical sha composed of a yellow, gelatinous substance. These tions are composed of a mass of the fungous filament gelatinous substance which they secrete. In them a duced the spores of this, the *teleuto* stage. These are composed of two cells and borne on long stalks sudden appearance of these peculiar growths on ceda just after a spring rain is often taken for the blossom the tree, but is in reality the fructification of the parasitic upon it. The gelatinous appendages of th "apples" soon dry up and wither away after the ra not until the teleuto spores contained in them ha minated and produced secondary reproductive bodie *sporidia*. These are carried away in the air, and p to infect, not cedar trees, but quinces or one or tw related plants. Upon the surface of these they ge and produce filaments which grow into the substance young fruit or stems, and by their presence there ca

tortion in shape seen in affected specimens. Upon this st the fungus forms little pustules just beneath the sure, finally breaking out into the air as tubular projections. these are formed the yellow spores of this stage, called *idia*. These spores are unable to infest quinces again, upon cedar trees begin the development of a new gention of "apples," which will in turn produce teleuto res the following spring.

Treatment. — It is not often that the damage caused by disease is of great extent. Sometimes, however, it omes sufficiently troublesome to make it worth while to mpt to repress it. It is evident that the most vulnerapoint of the fungus causing the trouble lies in its inabilto reproduce itself continuously upon the quince. The st direct method of treatment, therefore, is to extermie all white and red cedars and junipers from the vicinity the orchard, and cut off all affected parts of the fruit s, or entirely destroy badly affected ones. This, for ious reasons, however, may not always be possible or irable. As to spraying methods, it has been found quite ctive to spray with Bordeaux mixture two or three times ing the spring, especially during or just after rainy ther, when the spores are being disseminated. It may be possible sometimes to remove affected twigs of ar and juniper trees before the spores have been proed.

his same fungus has also been unusually abundant during past season upon the fruit of various species of Cratæ(hawthorne), accompanied by an equal abundance of closely related species, Gymnosporangium globosum, n the leaves. We have also noticed these or related ies upon the fruit of the Japanese quince (Cydonia onica) and mountain ash (Pirus Americana).

The Brown Rot of Stone Fruits.

(*Monilia fructigena.* Pers.)

his well-known disease found in the past summer just conditions suited to its best development, and the peach, n and cherry crops suffered in consequence. The dis-

ease needs no description to those who have ever
raise any of the above-mentioned fruits. It appear
summer, some time after the fruit has set, often ju
comes to maturity, or even earlier in the season,
of its appearance depending a great deal upon the
a warm, rainy period being liable to bring it on at a
Indeed, it does not always wait for the production
upon which to make its attacks, but often develops
blossoms, causing them to abort, and spreading the
the young twigs upon which they are borne, results
death. Upon the fruit the rotting is almost alway
to some extent at the time of ripening, and, as
mentioned, often occurs earlier in the season w
weather is favorable, i. e., warm and moist. At su
the greater part of the crop is sometimes destroy
cherries the chief damage is done upon the ripe fr
peaches and plums, which have a longer season of r
the young fruit is more frequently affected. Early
are considered more susceptible to the disease than
varieties.

The cause of this disease is a mould-like fungus
parasite, nevertheless), which spreads its vegetat
ments through the affected fruit and thus causes it
Wet weather brings about the rotting of the fruit b
ing the growth of the fungus, not by its direct effect
which is affected begins to discolor and soften, and
ally dries up and shrivels into a shrunken mass al
stone. It often remains on the tree for months, es
in the peach. In the early stages of infection the
becomes covered over with little grayish spots of a p
dusty nature. These are clusters of the spores of
gus, produced in countless numbers on the ends of f
from the inside of the fruit which have pushed out
the surface. These spores, which serve to reproc
fungus, are extremely minute in size, so that *en ma*
appear as a fine dust. Being easily carried by th
they are spread far and wide, and may thus infect
district in a few days, under favorable conditions.
becoming dry and hard the affected fruits cease pr

es, but their period of harmfulness is not yet ended. r lying over winter in a dormant state, the fungus in 1 is again aroused to life by the warm rains of spring, begins the production of spores which are ready to in- the crop about to be produced.

has been thought practicable by some to exterminate or ast greatly reduce this disease by the destruction of all ted fruit and thus prevent the fungus from surviving igh the winter. The variety of fruits upon which it exist, however, and the practical hopelessness of accom- ing the destruction of any considerable proportion of gether with the uncertainty of the fungus being alto- er dependent upon the dormant stage found in the l-up fruit for its existence over winter, make the suc- of this plan very doubtful. We would not, however, urage the practice of removing and destroying the ted fruit, especially any remaining upon the trees over er; for this may result in future decrease of the rotting, cially in isolated orchards or trees.

e usual methods of orchard spraying have been found ep this disease in check to a considerable extent, though vorable weather it will often sweep through an orchard, ite all precautions. The spraying should be begun , and kept up through the season with considerable iency, especially near the time when the fruit is matur- For such spraying, Professor Maynard recommends use of the ammoniacal copper carbonate or a weak ion of copper sulphate. Details in regard to the treat- of this disease may be found in Bulletin 44 of this on.

The Chrysanthemum Rust.

(*Puccinia Tanaceti*, S.)

the last annual report a rust upon chrysanthemum s was described, this being, as far as known, the first ished mention of such a disease. The specimens were by Mr. G. H. Hastings of Fitchburg, who had experi- d heavy loss as the result of the rust. This was the occurrence of the disease encountered during 1896.

This year it has appeared in many places, both in
other States, occasioning considerable loss, as it is of
destructive to infected plants. It is not yet g
known, however, among those who cultivate the chr
mum, though we fear that it may be by another year.
ing from the history of many similar diseases (a
rust, carnation rust, hollyhock rust, etc.), it will
surprising if a general epidemic of this disease occ
year. It will be well worth while, therefore, for gr
take precautions for guarding against it as much as
especially those whose stock is already infected. G
should be exercised to get cuttings from vigorous
unaffected by the rust; and it will no doubt be pro
the end to spray them a few times during the sum
the Bordeaux mixture or potassium sulphide, using o
of the latter in two gallons of water, or stronge
leaves will stand it. Should the rust appear on th
plants, they should certainly be sprayed at once an
quent intervals thereafter, and the affected plants
and destroyed. It will be useless to try to save
they are doomed to destruction, or at best will on
a weak, sickly, worthless growth. When the pl
placed in the benches for the fall, great care should
that no rusty specimen goes in, else it may bring a
ruin of the entire lot. Further than these suggesti
more can be said about the disease until time sh
shown what its seriousness may be and to what exte
be controlled.

There are several other diseases affecting the leav
chrysanthemum, so that some may be in doubt whet
plants are really infested with the rust. It causes
ation of the leaves, like other less destructive dise
may be distinguished from them by its production
pustules, of a dark-red, powdery substance, on th
side of the leaves, something as in the carnation rus
red powder consists of the spores of the fungus, w
produce and disseminate it.

A Disease of the Cultivated Geranium.

ing the past summer there appeared upon the leaves of geranium plants upon the college grounds a disease appears to be different from anything heretofore de-. The plants in question grew in a long border bed, mprised several different varieties. Along the back f the bed, trees and low shrubbery hung over to a erable extent, so that the plants in that portion were haded, while those in front were exposed more directly sun. The disease came on in the latter part of July, the rainy weather then prevailing. The leaves began yellow in small spots, which gradually increased in he leaf tissue dying away at those points; thus the soon became covered with dead spots of considerable nd finally lost their vitality completely. The plants front of the bed were most affected, those in the portion showing little or none of the disease. All es, as above mentioned, were equally affected. The were sprayed with the Bordeaux mixture, but with no nt success. The same disease was brought to our no-Northampton and also in the eastern part of the State. trouble appeared to be the result of the attack of some , but investigation of the affected leaves failed to re-ny such organism. Neither was there any evidence presence of insects. Numerous bacteria, however, ound in all affected tissue, and appeared to be the f the spotting of the leaves. We do not consider this ine disease of the geranium, nor do we expect to find it ng in the future. That the plants were in a condition vitality and hindered growth by reason of the exces-oisture, and hence were an easy prey to organisms ordinarily would be unable to affect them, seems the robable explanation. The futility of spraying to pre-ich a disease becomes apparent when its real nature is d.

Some Leaf Blights of Native Trees.

ng the past season several different kinds of trees een so generally affected with certain leaf-attacking s to become almost entirely defoliated before the end

of the summer. While of no great economic or importance, these attacks have been so marked effects so conspicuous that a brief description of th of the trouble may be of interest. The following were generally prevalent wherever the host trees over the considerable portion of New England whic ited during the summer.

A Leaf Blight of the Sycamore or Buttonwoo

(*Glocosporium nervisequum* Fckl. Sacc.)

Numerous inquiries reached us during the sp early summer concerning the very prevalent and de blighting of the leaves of the sycamore tree (*Plata dentalis*). It is probable that every good-sized tre species in the State was attacked by the disea younger trees were apparently, for some unexplaine less susceptible. The trouble appeared in May, trees, which had just leaved out, appeared as if been nipped by a frost or scorched by fire. The lea ered and turned brown, the new twigs were killed of the leaves fell to the ground. In this condition lost all beauty, and became unsightly objects. Th is not entirely new in this State, although it has ne so generally prevalent before. It was first describe many in 1848, and has been common in various Europe since then. In this country it has occurre within the last fifteen years. It first appeared in th of Columbia, Ohio, Kentucky and other parts of th south of here, but is now widespread.

The cause of this disease is a parasitic fungus, g the leaves and young twigs of the tree, and caus death. Several other fungi are usually found in c with the disease, and may have something to do i it. This disease is a very serious drain upon the v the tree, and often results in its death. Its occurre in the season, however, favors the tree, since it has to, and in fact does, produce a new crop of foliage it through the season. This exhausts the tree, how if repeated for several seasons is likely to cause its

As to a remedy for this disease, there is little to say. Spraying with fungicides is not to be practically considered, on account of the size and small economic importance of the tree. Gathering and burning diseased branches and leaves might lessen the trouble somewhat; but, if the disease continues to prevail, it will probably be best in the end to dispense with the sycamore as an ornamental tree, and plant something else instead.

A Leaf Blight of the Butternut.

(*Glocosporium Juglandis* (Lib.) Mont.)

No fungous disease has been more noticeable throughout the State during the past season than this. It first became apparent in July, when butternut trees were noticed to be losing their foliage. Examination showed that the rapidly falling leaflets were covered with dead and discolored spots, and had lost their vitality. All trees were not affected in the same degree, as some were almost completely defoliated in August, while others were attacked later or lost their leaves more slowly. By October 1, however, it was almost or quite impossible to find a butternut tree which had not lost the greater part of its leaves.

The cause of the trouble is a fungus, which lives in spots in the leaf, killing the tissue at these points and gradually causing the death of the whole leaflet, so that it falls to the ground. The disease spreads rapidly from leaf to leaf and from tree to tree, and many trees are soon defoliated. It is a well-known fungus, but has been unusually abundant this year.

A Leaf Spot of the Chestnut.

(*Septoria ochroleuca* (B. and C.)

This is another disease, quite similar to those above described, which has been very prevalent this year. It first became noticeable in July, when the ground under chestnut trees was covered with fallen leaves. Upon these leaves the fungus manifested itself very prominently in small, round, dead spots, about one-eighth of an inch in diameter, scattered over the surface more or less abundantly. These spots are the points where the fungus has become estab-

lished and killed the tissue. The fungus, like causing these diseases, reproduces itself by spo are produced in minute cavities in the dead are on the under side of the leaf. Almost all the affected trees become dotted over with the little c and most of them fall to the ground before their weakening the tree. The disease is not, howeve cially destructive one, except to the beauty of the

A Leaf Spot of the Wild Black Cherry

(*Septoria cerasina*, Pk.)

The well-known "shot-hole" fungus, which of extensive damage to the plum and cherry, has be ingly abundant this year upon the leaves of the cherry (*Prunus serotina*), many trees being almo leafless in August. This fungus attacks the leaves and cherries of several species, producing dead s them, and eventually causing their death. In with the wild cherry the disease has little econon tance, except as it may spread from that tree to species. On this account, the destruction of the w so desirable for the repression of the black kno caterpillar, is even more advisable.

BACTERIAL BLIGHT OF GERANIUM

QUINCE.

REPORT OF THE HORTICULTURIST.

SAMUEL T. MAYNARD.

he lines of work in this division the past season have
ı largely the same as for 1896.

Raspberry Seedlings.

he collection of raspberry seedlings, now three years produced a large crop of fruit the past season, and many t promising varieties were found among them. These llings were from the hybrid or purple-cap variety *Shaffer*. y produced a great variety of forms, from the black-cap e (*Rubus occidentalis*), the hybrid type of the parent, to e of the most beautiful forms of the red raspberry *ıbus strigosus*) and to albino forms of both species. eful records of the hardiness of cane, vigor of growth, e of ripening, productiveness and quality were made ing the season, and at this time the plantation is a very dsome one.

ınother collection of seedlings from the same source, but year younger, also shows many interesting forms of wth.

Seedling Currants.

ıbout three hundred seedling currant bushes two years have made a good growth and show many interesting ieties.

Grape Seedlings.

'he collection of seedling grapes, numbering some six ıdred varieties, is very interesting. The growth has been y vigorous and healthy, and most of them are in a conion to yield enough fruit next season to determine some-

thing of their value. From the appearance of th
and the growth of vine we may look for a great v
types of fruit.

Strawberry Seedlings.

This collection, numbering about four hundred
is in a very fine condition, and some varieties ha
decided merits.

Named Kinds of Strawberries.

Many new varieties of strawberries of decided m
been added to the collection. Many of the older
of little merit have been discarded, and the plo
time never looked so well.

Strawberry Field.

The field crop is planted on the knoll south o
farm buildings, and is in a remarkably good
This land is of a gravelly nature, but with a rete
soil of hardpan, which in an ordinarily moist seaso
depended upon to produce a large crop of fruit,
very dry time suffers severely. The land slopes
manner that either the trench system or the spra
tems of irrigation or sub-irrigation can be employe
of drought. Two reservoirs on the grounds are
for this purpose, and the three methods may be
tively tested. A considerable quantity of two an
and two inch pipe on hand is available for this wo
need not be of any great expense, while its imp
very great, as no comparative results have ever
tained that show whether any of the methods can
ably employed, or which is the most valuable.

Variety Testing.

The value of the comparative tests of varieties
vegetables, flowers, etc., is often discussed. Th
legitimate and important part of the work of the
shown in the demand made for the publications rec
results of such tests. When we consider the larg

ew varieties of fruits, vegetables, etc., offered to the ic every year at high prices, with the claim of merits them far above those of the standard sorts, and which average grower cannot afford to buy and test, it is cer- that the stations can save the people much loss and ex- se.

the work of variety testing at this station in past years, reports show that the new varieties reported as being the valuable have been those that later were considered valuable and were most largely grown by the commer- grower, while the varieties reported as having little or alue have been everywhere soon discarded by the grow- who tested them. This work would be of much greater e, without doubt, if one or more sub-stations in different s of the State could be established, where the same var- s could be tested under different conditions of soil and osure.

he large number of new varieties of all kinds of fruit, tables, etc., being introduced every year, and generally extravagant claims of merit, renders this work of the eriment Station imperative, and the people should refuse urchase such varieties until they have the endorsement he stations of several States. A single season's trial of riety is of very little value. It requires several years, east, to prove the value of vegetables or even the more y maturing small fruits, while tree fruits require a much ger period.

Other Experiments.

mong the other experiments now under way may be tioned the destruction of greenhouse insects by the use ydrocyanic acid; the testing of the value and keeping lities of some fifty-five varieties of celery; sub-irrigation rowing lettuce under glass; the use of different kinds of ch for strawberries; methods of overcoming the aspar- s rust; testing varieties of dwarf Lima beans, etc.

eports will soon be made of the results of the variety s of fruits, vegetables, etc.; the use of "Laurel Green" n insecticide and fungicide; of arsenate of lead as an in- icide; and of other work done during the year.

REPORT OF THE CHEMIST

DIVISION OF FOODS AND FEEDI

J. B. LINDSEY.
Assistants, E. B. HOLLAND, F. W. MOSSMAN, B. K. JONES, I

PART I.—LABORATORY WORK.

Outline of Year's Work.

PART II.—FEEDING EXPERIMENTS AN STUDIES.

PART I.

EXTENT OF CHEMICAL WORK.

The work of the chemical laboratory connecte department has very materially increased durin year. There have been tested 150 samples of samples of milk, 2 samples of oleomargarine, 1 butter, 123 samples of miscellaneous substances. tion to the above, which were sent to the station nation, there have been analyzed 260 samples o 388 samples of feed stuffs, in connection with e in progress by this and other divisions of t making a total of 1,147 substances which h through the laboratory within twelve months. also been carried on, for the Association of Officia ural Chemists, chemical investigations, relative t

best adapted for the estimation of starch in agricultural ducts. This has involved a great amount of chemical rk, the extent of which it is impossible to express in mere ires.

Character of Chemical Work.

Water. — The analyses of water have been made by the ie methods as heretofore, and with the same end in view, nely, to aid farmers and others in guarding against the ger arising from the use of waters coming from polluted ings and wells. Illness frequently occurs in the family, cause of which it is often difficult to explain, until an mination of the water reveals its pollution with sink, vy, stable or other drainage. The waters tested show ch the same condition as in former years; in round num- s, 15 per cent. could be pronounced excellent, 40 per t. fair, 25 per cent. suspicious and 20 per cent. danger- for drinking. Fully 50 per cent., therefore, were con- ered of a suspicious character. Three samples were nd to contain lead, and had been known to have produced l poisoning. We can only repeat the advice given in ner years, in cautioning all who are obliged to depend n wells and springs for their water supply to take every caution to prevent any drainage from entering, and to p the grounds about the well or spring free from all ectionable matter. Lead pipes should never be used to w water through, especially if the water is free from min- matter (soft).

Milk. — The most of the milk received at the station has n sent by farmers who ship their milk to Boston con- tors. They had probably been notified by the contract- that their milk was below the Massachusetts standard,* they wished to ascertain its exact quality, and what, if thing, could be done for its improvement. The larger t of this milk was found to contain 12 to 12.5 per cent. solids and from 3.25 to 3.50 per cent. of fat, and was in probability the unadulterated product of the cow. The tractor, however, because of the large amount of milk

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The Massachusetts standard calls for 13 per cent. solids and 3.70 per cent. fat, pting during April, May, June, July and August, when but 12 per cent. solids 3 per cent. fat are required.

offered, can afford to be particular, and desires or
to, or above the legal standard. In such case
nothing for the farmer to do but to add some gr
or Guernsey cows to his herd. It certainly would
step forward, if milk were sold not simply as milk
a guarantee of composition. Milk containing 11.
solids and 3 per cent. of fat should surely brin
quart than milk containing 12, 13 or 14 per cent.
3.25, 4 or 5 per cent. fat.

Cattle Feeds. — At its session of 1897, the St
lature passed a law authorizing the inspection of
The work is being carried out by this department
hoped that it will result in keeping out poor and
material, and in keeping the regular articles of as
composition as possible. Considerable adulterat
seed meal was found on the market during the e
months. This material consisted of a mixture of
meal, the former ground very fine in order to
identity. The adulterated product contained from
per cent. of protein, while a prime meal should
40 to 45 per cent. Farmers were warned through
cultural and daily papers of the presence of the
article, and cautioned against its purchase. The
this has been to produce a feeling of uncertainty
strict the use of the genuine article. To overcom
American Cotton Oil Company have placed a gu
composition upon every bag put out by them. I
other manufacturers will follow this example.
should by all means give the preference to the
article.

Other new feed stuffs are those put out by the
pany, under the name of dairy, horse and pou
The feeding values of these feeds are being in
Varieties of oat feeds, being mixtures of oat hulls
or less corn meal, are found in the market withou
guarantee. Farmers are cautioned against their
for the reason that the price asked is, as a rule, c
in excess of their feeding value.

Methods for the Determination of Starch. —
undertaken for the Association of Official Chemis

d to, has been reported to them. While more work
done along this line, it has been quite clearly demon-
l that the so-called Maercker and Reinke methods for
imation of starch in agricultural products are faulty,
ll give altogether too high results. The only method
which reasonably accurate results may be expected is
astase or malt method,* and this method has been
d by the official chemists in place of all others.

PART II.

EXPERIMENTS WITH PIGS.

experiments have been completed with pigs, and a
is now near completion. These experiments were
ed to study the value of corn meal as compared with
y and cerealine feeds for pork production, when fed in
nation with skim-milk. Both these feeds are quite
r in composition. They consist of the hull, germ and
or less bran and starch removed from white corn, dur-
e preparation of cracked hominy and cerealine flakes
man consumption. Cerealine is much more bulky
he hominy feed. These experiments will be published
il later. It can be said, however, that pigs have made
, and in some cases fully, as good growth on these
s on an equal amount of corn meal.

SALT MARSH HAY.

horough investigation has been completed concerning
neral character and feeding value of salt marsh hay.
sults are being published in bulletin form. The prac-
onclusions, briefly stated, are as follows: —

several varieties of salt hay have, ton for ton, from 10
per cent. less feeding value than average English hay.
10 to 12 pounds of salt hay were fed daily, together
or 8 pounds of grain and a bushel of ensilage, the
produced within 2 to 5 per cent. as much milk and

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* ...ase's method can be used for estimating starch in commercial starch and in
...

butter as an equal amount of English hay simil
bined.

Because of the less market value of salt as comp
English hay, rations containing the salt hay, as giv
produced milk and butter from 10 to 20 per cent.
did rations containing English hay. No objection
was noticed when the salt hay was fed directly afte

It is undoubtedly wise for farmers living nea
marshes to feed salt hay and sell English hay. F
sults in detail, and a fuller discussion, see the bull

Digestion Experiments.

During the past year we have studied the amount
nutriment in salt hays, to which reference has alr
made, in a number of new by-products and in gr
for soiling. Many of our results, together with
conclusions therefrom, will soon be ready for publi

TON-SEED FEED AS A HAY SUBSTITUTE FOR MILCH COWS.

J. B. LINDSEY, E. B. HOLLAND AND B. K. JONES.

The Experiment concisely described.

hat Cotton-seed Feed is. — The seeds of the cotton plant rregular, egg-shaped in form, and almost hidden by a of white fibre which covers their surface. The meat of eed is covered with a thick, tough hull of a black color. ines have been invented to remove this hull, and the is subjected to warm pressure for the purpose of re- ng as much as possible of the oil. The pressed meat or is ground, and results in the decorticated, bright yellow n-seed meal of commerce. The black hull, covered with white fibre, was formerly almost entirely used as fuel, the ashes were sold for fertilizing purposes. Of late southern farmers, at the recommendation of experi- stations in the south, have been mixing these hulls with otton-seed meal and feeding them to beef and dairy cat- vith very good success. Within the last few years this rial, under the name of *cotton-seed feed*, has been offered ır Massachusetts markets. The manufacturers claim the feed consists of 1,600 pounds of hull and 400 ds of meal, thoroughly mixed by machinery. The price ;ed has been $13 per ton in car lots, delivered in Mas- ısetts, which would be equivalent to at least $15 in sin- ons. The feed, shipped in bags, is quite bulky, and, ıse of the white fibre covering the hull, looks somewhat wool waste. Its color is light yellow, due to the ad- ıre of the cotton-seed meal.

The Experiments briefly stated.

ıe experiment station has conducted four experiments this feed, two with milch cows and two with sheep.

The feed for the first experiment was furnished by ufacturers. In the second experiment we procure arate ingredients, and mixed the feed ourselves. the two milk experiments was made with six cow first experiment the feed consisted of a constant ensilage ration, together with a good quality of fi and cotton-seed feed; in the second experiment t constant grain and mangel ration, in addition t and cotton-seed feed. The cotton-seed feed was lo as being similar in character to hay, and, in atte get at its value, from 12 to 15 pounds were daily for a like quantity of hay. The first experin twenty-one days and the second twenty-eight days of digestion experiments, in which six single tests some of the sheep received nothing but the cotton and others received half hay and half of the fee the cotton-seed feed has not an attractive appea animals in all cases ate their daily rations with n objections.

The Results.

I. The total average gain of the six cows in during the cotton-seed period was 95 pounds, and hay period 166 pounds.

II. The production of milk, milk solids and was so nearly alike in the average of both experin be within the limits of experimental error.

III. The cost of producing milk and butter wi and with the cotton-seed ration varied but very lit

IV. A ton of cotton-seed feed contained pounds of digestible matter, and a ton of the 1,007 pounds of digestible material.

V. A full description of the experiments, tog all data bearing on the results, will be found furth

Is Cotton-seed Feed economical for Mass Farmers?

There would unquestionably be no advantage fo age farmer to feed this material in place of hay could sell his hay for a sufficient advance over

the feed to warrant the change. Milkmen in the vicinity of large cities, and others who are obliged to purchase their coarse feed, might find it to their advantage to use some of this material, especially if it could be bought for less than a good quality of hay. It is possible that animals would tire of this feed sooner than of hay. The cows used by the station consumed it continuously for over a month with no seeming objections. The cotton-seed feed must be looked upon from a feeding stand-point in the light of a hay substitute, and not as a grain feed, and only 8 to 10 pounds should be fed each animal daily, in place of a like amount of hay or other coarse fodder. Southern rather than northern farmers can utilize cotton-seed feed to the best advantage.

The Experiments in Detail.

In 1889 Stone * records the fact that increasing quantities of cotton-seed hulls and various mixtures of hulls and cotton-seed meal were being fed by the farmers of the south for beef and milk production. Since 1889 a great variety of digestion and beef-producing experiments have been made by the North Carolina station,† which have been productive of a large amount of information relative to the physiological and economic value of cotton-seed feed. The Texas experiment station ‡ has made experiments with milch cows to study the economic value of this feed in a variety of fodder rations.

In 1894 Armsby § published the results of two experiments with cotton-seed feed. In the first experiment the cows, five in number, were fed as follows: Ration I. consisted daily of 7.95 pounds of wheat bran and 11.69 pounds of cotton-seed feed; while Ration II. contained 3 pounds of cotton-seed meal, 7 pounds of corn meal, 6 pounds of corn fodder and 3.27 pounds of hay. Practically, the corn meal and cotton-seed meal of the second ration were matched against the bran, and cotton-seed meal contained in the cotton-seed feed of the first ration, leaving the corn fodder

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* Tennessee Experiment Station, Vol. II., No. 3, 1889.

† Bulletins 80*c*, 81, 87*d*, 93, 97, 106, 109, 118.

‡ Bulletin 33, 1894.

§ Report Pennsylvania Experiment Station, page 44, 1894.

and hay to be compared with about the same q
cotton hulls. The results, as would naturally be
were in favor of Ration II. This latter ration
also 4 pounds more of digestible matter. In t
trial, six cows were each given daily 6 pounds
gluten feed and 2 pounds of wheat bran. Rati
tained in addition 10.6 pounds of cotton-seed
Ration II. 4 pounds of corn meal and 9.7 pounds
hay. It is not possible to regard this as a fair co
for any one can see at a glance that 4 pounds of
and 9.7 pounds of clover hay (13.7 pounds)
better results than 10.6 pounds of cotton-seed
least a fairer comparison would have been to hav
the cotton-seed feed against a like quantity of c
Simply because cotton-seed feed consists of a n
cotton-seed hulls with cotton-seed meal, it is
necessary when making a comparison to put the li
of cotton-seed meal or other grain into the oppo
By so doing, one simply compares cotton-seed
some other fodder or fodder combination. The h
selves have an inferior nutritive value; experin
demonstrated that their nutritive effect is increa
addition of the cotton-seed meal. In order, th
get at the feeding value of this material, it must b
as a single feed stuff, and ought to be compared
coarse fodders of similar composition. It has be
of the experimenter, in the two experiments that
make such a comparison.

A. Composition of Cotton-seed Fee

The first lot of feed, supplied through the k
Mr. H. C. Haskell of the Southern Cotton Oil C
Savannah, Ga., was said to have been mixed in t
tion of 1,600 pounds of hulls to 400 pounds of n
lot for the second experiment we prepared oursel
same proportion. The two lots varied very little
ure, but, for the sake of more exact comparison, t
are presented in dry matter.

	No. 1 (Per Cent.).	No. 2 (Per Cent.).	Theoretical Protein Content of No. 2 (Per Cent.).	Composition of Two Samples of Hay fed in the Two Experiments (Per Cent.). I.	II.
. . .	3.82	3.51	-	5.94	5.78
n, . .	13.02	11.98	13.85	11.07	8.41
. . .	39.67	40.69	-	32.00	33.98
t matter, .	39.59	40.13	-	47.92	49.15
. . .	3.90	3.69	-	3.07	2.68

th Nos. 1 and 2 run rather below the theoretical per-ge of protein. This is not surprising, from the fact t is extremely difficult to get a strictly average sample is feed. It is impossible to grind the hulls fine, and in of all one can do, more or less of the meal will fall gh the hulls and not be included in the sample. It be noted that the cotton-seed feed and the hay resemble other in chemical composition, excepting that the cot-eed feed contains somewhat more fibre and less extract er.

B. Digestibility of Cotton-seed Feed.

cognizing the valuable information secured by digestion six single trials with sheep were made of the two sam-of feed. The sheep were grade Southdown mature weth- In four cases the cotton-seed feed was fed alone, and in emaining two the daily ration consisted of one-half hay one-half cotton-seed feed. In both cases the results quite closely, except in case of the fat, which showed estibility of 98 per cent. when the cotton-seed feed was n connection with hay. This high result it was thought to exclude from the average. The cotton-seed feed ap-d to agree better with the sheep when fed in connection hay than when fed by itself. In the latter case, at the of the period the sheep began to show signs of diges-

tion disturbances, which would certainly have be
pronounced had the feeding been continued mu
The digestibility of the two different samples of
feed was practically the same. The North Carol
has made a very extended study of the digestibili
and meal fed in different proportions. The Pe
station has also made three single determinatio
results, in addition to our own, are tabulated belo

Digestion Coefficients.

	Proportions fed.	Number Single Determinations.	Dry Matter (Per Cent.).	Protein (Per Cent.).	Fibre
Massachusetts station,	4-1	6	56	41	
North Carolina station,	6-1	2	46	46	
North Carolina station,	4-1	2	54	54	
North Carolina station,	3-1 1½-1	9	54	64	
Pennsylvania station,	5-1	3	43	36	
Hay of mixed grasses with ten per cent. protein for comparison.	-	-	58	58	

The experiments made by the North Carol
(4–1) and by the Pennsylvania station were
with steers. The only difference between the
tained by the Massachusetts station and those r
the North Carolina station (4–1) consists in the
centage of protein and the lower percentage of fib
by the steers in the North Carolina experiments
efficients for fat digestibility also show some var
the fat percentage being comparatively small, th
is not of so much account. The coefficients o
Armsby are lower than would be expected. The
of digestibility for an extra quality of hay ar
noticeably higher — excepting the protein — tha
the cotton-seed feed.

According to the average coefficients of dig
ton of the hay and a ton of the cotton-seed feed

k experiments would contain the following amounts of estible organic nutrients: —

One ton hay,	1,007.3
One ton cotton-seed feed,	964.4

ne would therefore suppose that a ton of cotton-seed feed ld have nearly the same feeding value as a like quantity ay. There might be one exception to the above state-t, in that it is possible that rather more energy would equired to digest the cotton-seed feed than the hay.

C. Milk Experiments with Cotton-seed Feed.

Experiment I.

his experiment was conducted during April and May, . The animals, six in number, were evenly divided two lots. In order to counteract the natural milk nkage, three of the animals in the first half of the exper-nt were fed the cotton-seed feed ration, while the other e were having the hay ration. In the second half this r was reversed. Each half of the experiment lasted nty-one days, and from seven to ten days were allowed veen the halves.

History of the Cows.

AME.	Breed.	Age (Years).	Last Calf dropped.	Number of Days with Calf.	Milk Yield at Beginning of Experiment (Pounds).
. .	Grade Ayrshire,	7	Oct. 1	106	19
Spot, .	Grade Durham, .	6	Sept. –	90	21
e, .	Grade Ayrshire,	7	Sept. 10	69	25
ty, .	Grade Jersey, .	5	Sept. 15	96	20
. .	Grade Durham, .	7	Oct. 8	141	20
. .	Grade Durham, .	7	Oct. 8	141	20

ive of the above cows had been in two previous experi-ts since October, 1895.

Dates of the Experiment.

	Cotton-seed Ration.	
April 8 through April 28, ...	Cows 3, 4, 5	C
May 11 through May 31, ...	Cows 1, 2, 6	C

Rations consumed Daily (Pounds).

PERIOD.	Name.	Hay.	Cotton-seed Feed.	Wheat Bran.	Peoria Gluten Feed.	Lins Mea
Cotton-seed feed.	Ada, . .	–	10	2	3	1
	Red Spot, .	–	13	3	2	2
	Bessie, . .	–	15	3	2	2
	Beauty, . .	–	15	3	2	2
	Red, . . .	–	15	3	2	2
	Spot, . .	–	13	3	2	2
Hay.	Ada, . .	10	–	2	3	1
	Red Spot, .	13	–	3	2	2
	Bessie, . .	15	–	3	2	2
	Beauty, . .	15	–	3	2	2
	Red, . . .	14.2	–	3	2	2
	Spot, . .	13	–	3	2	2
Average cotton-seed feed.		–	13.5	2.83	2.17	1.8
Average hay, . .		13.47	–	2.83	2.17	1.8

Although but three of the six cows received
ration at the same time, each animal received dur
periment the two different rations for exactly the s
of time. It will be observed that the only diff
tween the rations consists in the substitution of

eed for the hay, and *vice versa*. The entire rations aten clean, excepting a small amount of hay refused d, which was preserved, analyzed and deducted from al fed. The feeds were weighed out daily and given portions. Water was before the animals constantly. ws were carded daily, and allowed the run of a yard sant weather.

Digestible Nutrients in Daily Rations (Pounds).

Name.	Total Dry Matter.	Digestible.				Nutritive Ratio.
		Protein.	Carbohydrates.	Fat.	Total.	
a, . .	17.36	1.77	8.30	.67	10.74	1:5.63
d Spot, .	21.88	2.23	10.10	.82	13.15	1:5.45
ssie, . .	23.42	2.31	10.82	.86	13.99	1:5.61
auty, . .	23.42	2.31	10.82	.86	13.99	1:5.61
d, . .	23.42	2.31	10.82	.86	13.99	1:5.61
ot, . .	21.88	2.23	10.10	.82	13.15	1:5.45
a, . .	17.30	1.92	8.74	.50	11.16	1:5.20
d Spot, .	21.81	2.42	10.70	.59	13.71	1:5.03
ssie, . .	23.90	2.57	11.05	.64	14.26	1:4.92
auty, . .	23.90	2.57	11.05	.64	14.26	1:4.92
d, . .	23.19	2.53	10.72	.63	13.88	1:4.86
ot, . .	21.81	2.42	10.70	.59	13.71	1:5.03
e cotton-feed.	21.89	2.19	10.16	.82	13.17	1:5.56
e hay, .	21.99	2.41	10.49	.60	13.50	1:4.99

coefficients of digestibility for the cotton-seed feed or the hay used in calculating the above digestible nts were those obtained in our experiments with Average coefficients were used for the grain feeds. bove results show but little variation in the digestible nts of the several groups contained in the two rations.

Weight of Animals at Beginning and End of Experimen

		Ada.	Red Spot.	Bessie.	Beauty.	
Cotton-seed period,	Beginning,	771	891	795	937	1
	End,	771	888	792	928	1
Hay period,	Beginning,	775	892	861	1000	1
	End,	775	902	855	1012	1

Two weights were taken of each animal at th
and two at the end of the experiment. No ma
tions were noted due to the influence of either ra

Yield of Milk and Butter.

PERIOD.	Cows.	Total Yield of Milk (Pounds).	Daily Yield of Milk (Pounds).	Daily Yield of Milk (Quarts).	Total Milk Solids (Pounds).	Total Butter Fat (Pounds).
Cotton-seed Feed.	Ada,	395.48	18.83	8.76	54.60	19.53
	Red Spot,	439.12	20.91	9.72	62.58	22.89
	Bessie,	542.11	25.71	11.96	73.50	26.67
	Beauty,	444.00	21.14	9.83	66.99	24.99
	Red,	416.62	19.82	9.22	58.38	21.00
	Spot,	337.25	16.06	7.47	50.82	18.27
Hay.	Ada,	402.71	19.18	8.92	54.60	18.60
	Red Spot,	458.75	21.84	10.16	64.05	21.29
	Bessie,	526.86	25.09	11.67	70.35	23.81
	Beauty,	399.89	19.04	8.86	58.17	20.35
	Red,	275.50	13.12	6.43	38.22	12.84
	Spot,	419.50	19.98	9.29	61.53	22.11
Total cotton-seed feed,		2,574.58	122.47	56.96	366.87	133.33
Total hay,		2,483.21	118.25	55.33	346.92	119.00
Percentage increase cotton-seed feed over hay.		3.6+	-	-	5.44+	10.76+

The cotton-seed feed ration gave a slightly lar
of milk than the hay ration. A 5.4 percentage
the amount of total solids is also noted, while fu

cent. more butter fat was produced by the cotton-seed ration. This latter result could hardly have been expected. Should cotton-seed feed exert a favorable influence in increasing the relative amount of butter fat in the milk, other experiments would show similar results, which we shall presently show has not been the case. A part of the decrease in the amount of milk, solids and fat produced by the hay ration can be accounted for in the sudden shrinkage of Cow V. (Red) in the second (hay) period. This cow was a grade Durham, and at the beginning of her second period was about 105 days from calving time. She began then to dry off rapidly, showing a shrinkage of 34 per cent. in yield of milk from that produced in the previous period, while other animals shrank only from 5, to in one case 20 per cent. Had Red shrank only 20 per cent., the total decrease in milk yield in the hay period would have been but a trifle over 1 per cent. The results of this experiment make rather more of a favorable showing for the cotton-seed feed than one would naturally expect, judging from its composition and digestibility. Before, therefore, drawing positive conclusions, the reader is referred to the results of a second experiment, described further on.

Dry and Digestible Matter required to produce Milk and Butter (Per Cent.).

Dry Matter required to Produce —	Cotton-seed Period.	Hay Period.	Digestible Matter required to produce —	Cotton-seed Period.	Hay Period.
100 pounds milk,	107.10	111.56	100 pounds milk,	64.40	68.49
1 pound milk solids,	7.52	7.98	1 pound milk solids,	4.52	4.90
1 pound milk fat,	20.69	23.27	1 pound milk fat,	12.44	14.28
1 pound butter,	17.75	19.99	1 pound butter,	10.68	12.27

Market Cost of Feed Stuffs.

Wheat bran,	$15 00	per ton.
Peoria gluten feed,	15 00	"
Linseed meal,	20 00	"
Millet and soya bean ensilage,	3 50	"
Hay,	15 00	"
Cotton-seed feed,	15 00	"

With the above figures as a basis, we obtain th
figures for the cost of feed required to produc
butter: —

	Cows.	Daily Feed (Cents).	100 Pounds Milk (Cents).	Quart of Milk (Cents).	Pou Butte (Ce
Cotton-seed period.	Ada,	14.87	79.00	1.69	15
	Red Spot,	19.00	90.90	1.95	17
	Bessie,	20.50	79.70	1.71	16
	Beauty,	20.50	97.00	2.08	17
	Red,	20.50	103.40	2.22	20
	Spot,	19.00	118.20	2.54	21
Hay period.	Ada,	14.87	77.50	1.67	16
	Red Spot,	19.00	87.00	1.87	18
	Bessie,	20.50	81.70	1.76	18
	Beauty,	20.50	107.60	2.31	21
	Red,	19.90	151.70	3.09	32
	Spot,	19.00	95.00	2.05	18
Average cotton-seed feed period.		19.06	94.70	2.03	18
Average hay period,		18.96	100.10	2.12	20

The two rations costing the same, the cost o
milk and butter was rather favorable to the cott
ration.

Experiment II. (1896).

In view of the results obtained in the first ex
was thought advisable to conduct a second under
the same conditions. The six cows were all ap
fresh in milk. The experiment was carried ou
the same way as the preceding one.

History of Cows.

NAME.	Breed.	Age (Years).	Last Calf Dropped.
y, ...	Grade Jersey, . .	9	July 1.
ie, ...	Grade Guernsey, .	6	September.
, ...	Grade Jersey, . .	10	August 23.
ty, . . .	Grade Jersey, . .	6	September 15.
. . . .	Grade Durham, . .	8	August 20.
. . . .	Grade Durham, . .	8	August 17.

he cows were farrow at the beginning of the experiment, all were served during the progress of the trial.

Dates of the Experiment.

	Cotton-seed Period.	Hay Period.
ber 6 through November 3, . .	Cows 1, 2, 5.	Cows 3, 4, 6.
ember 17 through December 15, .	Cows 3, 4, 6.	Cows 1, 2, 5.

Rations eaten Per Day (Pounds).

NAME.	Hay.	Cotton-seed Feed.	Mangolds.	Wheat Bran.	Chicago Gluten Meal.
Mary, ...	2	15	15	5	3
Jennie, . . .	3	12	15	5	3
Nora, ...	–	15	15	5	3
Beauty, . . .	5	15	15	5	3
Red, ...	3	15	15	5	3
Spot, ...	3	14.46	15	5	3

Rations eaten Per Day (Pounds) — Conclu

	NAME.	Hay.	Cotton-seed Feed.	Mangolds.
Hay period.	Mary, . . .	17	–	15
	Jennie, . . .	15	–	15
	Nora, . . .	15	–	15
	Beauty, . . .	20	–	15
	Red, . . .	18	–	15
	Spot, . . .	18	–	15
Average cotton-seed feed period.		2.68	14.41	15
Average hay period, .		17.17	–	15

It was not considered advisable to feed more t to 15 pounds of the cotton-seed feed daily, an tional quantity of coarse fodder was secured by 2 to 5 pounds of hay, to suit the appetites of animals. We have, then, 12 to 15 pounds of feed, compared with a like amount of hay. The feed was mixed daily in the proportion of 4 pou to 1 pound of meal. The hay was a mixture of Timothy predominating. Some clover was scatt the mixture.

Digestible Matter in Rations (Per Cent.)

	NAME.	Total Dry Matter.	Digestible.			
			Protein.	Carbohydrates.	Fat.	T
Cotton-seed period	Mary, . . .	23.20	2.45	10.58	.83	1
	Jennie, . . .	21.44	2.37	9.78	.76	1
	Nora, . . .	21.44	2.37	9.76	.81	1
	Beauty, . . .	25.83	2.57	11.82	.87	1
	Red, . . .	24.07	2.49	10.99	.85	1
	Spot, . . .	23.61	2.47	10.77	.83	1

Digestible Matter in Rations (Per Cent.) — Concluded.

NAME.	Total Dry Matter.	Digestible. Protein.	Carbohydrates.	Fat.	Total.	Nutritive Ratio.
Iary, . . .	23.17	2.41	10.67	.56	13.64	1:4.95
ennie, . . .	21.42	2.33	9.85	.54	12.72	1:4.77
Iora, . . .	21.42	2.33	9.85	.54	12.72	1:4.77
eauty, . . .	25.78	2.53	11.91	.60	15.04	1:4.30
ed, . . .	24.08	2.45	11.08	.58	14.11	1:5.00
pot, . . .	24.08	2.45	11.08	.58	14.11	1:5.00
ge cotton-seed l period.	23.26	2.45	10.62	.82	13.64	1:5.14
ge hay period, .	23.32	2.42	10.74	.57	13.72	1:5.00

ıe amounts and proportions of digestible matter in each ıe two rations are identical. In calculating the above ns, average digestion coefficients were taken for the ıs, the coefficients obtained at this station for the cotton- feed, and in case of the hay, the coefficients obtained ıs for hay of similar appearance and composition. It be remembered that the above digestible material in wo rations is only estimated. It is therefore quite pos- that, had actual digestion experiments been made with cows, these figures may have been somewhat modified.

ht of Animals at Beginning and End of Experiment (Pounds).

		Mary.	Jennie.	Nora.	Beauty.	Red.	Spot.	Total Gain.
-seed period, .	Beginning, . .	768	818	745	943	1,006	1,007	-
	End, . . .	767	840	767	954	1,042	1,002	85
riod, . . .	Beginning, . .	829	897	757	946	1,096	954	-
	End, . . .	825	888	780	973	1,115	1,024	126

he cows were weighed at the same time for three con- tive days at the beginning and end of the experiment.

Four of the six cows were rather thin in flesh a
ning of the test, and made gains on both rations
period showed a herd increase of 41 pounds over
seed period.

Milk and Butter Yields (Pounds).

PERIOD.	Cows.	Total Milk.	Daily Milk.	Daily Quarts.	Total Milk Solids.	Total Fat.
Cotton-seed period.	Mary,	596.88	21.32	9.92	83.38	29.29
	Jennie,	609.97	21.78	10.13	88.81	30.50
	Nora,	519.12	18.54	8.62	69.81	23.02
	Beauty,	587.68	20.99	9.76	84.75	30.97
	Red,	549.94	19.64	9.13	67.63	21.28
	Spot,	428.77	15.31	7.12	62.23	22.42
Hay period.	Mary,	575.64	20.55	9.57	79.83	27.34
	Jennie,	527.12	18.82	8.75	80.49	30.46
	Nora,	613.34	21.89	10.17	80.77	24.78
	Beauty,	685.67	24.47	11.38	97.85	33.60
	Red,	557.00	19.89	9.25	69.62	22.72
	Spot,	491.17	17.56	8.17	70.83	23.23
Average cotton-seed feed ration.		548.73	19.59	9.10	76.10	26.18
Average hay ration,		574.99	20.53	9.55	79.90	27.02
Percentage increase hay over cotton-seed period.		4.6+	-	-	4.8+	3.1+

In this experiment, the results are the reverse
tained in the first test, the hay period yielding
cent. more milk, milk solids and fat. Our obs
the animals from day to day during the trial in
the cotton-seed feed ration was falling slightly
hay ration. The animals, being in the early
lactation period, would naturally be more sens
effect of food than in the latter portion of th
lactation.

d Digestible Matter required to produce Milk and Butter (Per Cent.).

...ER REQUIRED ...ODUCE —	Cotton-seed Period.	Hay Period.	Digestible Matter required to produce —	Cotton-seed Period.	Hay Period.
... milk, . .	118.70	113.60	100 pounds milk, . .	70.90	66.90
...ilk solids, .	8.56	8.18	1 pound milk solids, .	5.11	4.81
...ilk fat, . .	24.88	24.17	1 pound milk fat, .	14.86	14.22
...tter, . .	21.38	20.70	1 pound butter, . .	12.77	12.18

Market Cost of Feed Stuffs.

...Vheat bran, ...	$14 00	per ton.
...hicago gluten meal, ...	18 00	"
...langolds, ...	3 00	"
...lay, ...	15 00	"
...otton-seed feed, ...	15 00	"

...f Feed to produce Milk and Butter. Average for Six Cows (Cents).

	Daily Feed.	100 Pounds Milk.	Quart Milk.	Pound Butter Fat.	Pound Butter.
...d period, ...	21.32	110.6	2.38	23.40	20.10
...d, ...	21.32	104.9	2.26	22.60	19.32
... percentage cost of cotton-...r hay period.	-	5.2+	-	-	3.2+

...cotton-seed rations slightly increased the cost of the ...nd butter.

... Average Results from Two Experiments.

... thought desirable to bring together the results of ...xperiments, believing that they will give a fair repre-...on of the relative values of like quantities of cotton-...ed and a good quality of hay.

...tal Live Weight gained by the Six Cows in Both Experiments (Pounds).

...otton-seed feed periods, ...	95
...lay periods, ...	166

2. Average Dry and Digestible Matter Consumed Dail

	Total Dry Matter.	Digestible.			
		Protein.	Fat.	Carbohy-drates.	Tota
Cotton-seed period,	22.57	2.32	.82	10.39	13.4
Hay period,	22.65	2.41	.59	10.61	13.6

These figures show very slight variations.

3. Total Milk and Butter Yields (Pounds)

	Milk.	Milk Solids.	Milk F
Cotton-seed period,	5867	823.5	290.
Hay period,	5933	826.3	281.
Percentage increase hay over cotton-seed,	1.1+	.34+	3.

These variations can be regarded as within the experimental error.

4. Average Feed Cost of Milk and Butter (Ce

	Daily Cost of Feed.	100 Pounds Milk.	Quart Milk.	P B I
Cotton-seed period,	20.19	102.6	2.20	2
Hay period,	20.14	102.5	2.19	2
Percentage increased cost of hay over cotton-seed.	±	±	±	

The 4.6 percentage increased cost of butter i period is due to the rather unexpected results i experiment.

5. Dry and Digestible Matter required to produce Milk

I. Dry Matter (Pounds).

	100 Pounds Milk.	Pound Milk Solids.	Poun Butter
Cotton-seed period,	112.9	8.04	22.7
Hay period,	112.6	8.08	23.7

II. Digestible Matter (Pounds).

	100 Pounds Milk.	Pound Milk Solids.	Pound Butter Fat.	Pound Butter.
d period, ...	67.65	4.81	13.65	11.72
d, ...	67.69	4.85	14.25	12.22

General Conclusions.

on-seed feed, from its appearance, is certainly not an ive looking article for consumption. The cotton-seed comprising the bulk of the feed, consists of the dark oats, together with an entangling mass of fibre. They fficult to masticate, and quite indigestible. The cot-ed meal with which the hulls are mixed imparts its to the material, and actually increases the digestibility hulls. In our experiments we have had no trouble in ng animals to eat 12 to 15 pounds daily within three r days. The two experiments have shown cotton-seed give as large milk and butter yields, at as low a cost, good quality of hay. The writer is of the opinion, er, that this feed requires more energy for its diges-an hay, and, when fed for any length of time, would tendency to induce digestive disturbances. A mix-f hulls and meal could probably be turned to better t for fattening steers than as a continuous feed for cows. Massachusetts farmers could derive no benefit eeding this material in place of hay. For those who liged to purchase all of their coarse feeds, it might be ble to use one-half of this material in place of hay, ed it could be purchased for somewhat less money. -seed feed should be consumed where it is produced. e farmers of the south it is undoubtedly a cheap source rse feed, and, when fed in moderate quantities, will stionably return good results.

Analytical Data.

Dry Matter Determinations (Per Cent.).

Experiment I.

	Hay.	Millet and Soy Bean Ensilage.	Cotton seed-Feed.	Wheat Bran.	Lin M
April 8 through April 28, .	90.33	18.79	89.00	87.89	9
May 11 through May 31, .	89.84	20.58	88.10	87.86	9

Experiment II.

	Hay.	Mangolds.	Cotton-seed Feed.	W B
Hay * and cotton-seed periods, . .	87.60	8.00	87.8	8

* The dry matter determinations varied so little in the two halves ment that the average in each case was taken.

Composition of Feeds (Per Cent.).

Experiment I.

	Hay.	Millet and Soy Bean Ensilage.	Cotton-seed Feed.	Wheat Bran.	Li M
Ash, ...	5.94	12.77	3.82	6.42	
Fibre, ...	32.00	34.02	39.67	11.37	
Fat, ...	3.07	2.59	3.90	5.73	
Protein, ...	11.07	9.40	13.02	18.68	4
Extract matter, ...	47.92	41.22	39.59	57.80	3

Experiment II.

	Hay.	Mangolds.	Cotton-seed Feed.	W B
Ash, ...	5.78	15.49	3.51	
Fibre, ...	33.98	10.67	40.69	1
Fat, ...	2.68	.73	3.69	
Protein, ...	8.41	14.35	11.98	1
Extract matter, ...	49.15	58.76	40.13	5

Coefficients of Digestibility.

Experiment I.

	Hay.	Ensilage.	Cotton-seed Feed.	Wheat Bran.	Linseed Meal.	Peoria Gluten Feed.	Chicago Gluten Meal.	Mangolds.
Fibre,	66	69	50	22	57	78	-	-
Fat,	53	72	89	71	89	79	-	-
Protein,	62	57	39	78	89	83	-	-
Extract Matter,	64	59	58	68	78	90	-	-

Experiment II.

	Hay.	Ensilage.	Cotton-seed Feed.	Wheat Bran.	Linseed Meal.	Peoria Gluten Feed.	Chicago Gluten Meal.	Mangolds.
Fibre,	58	-	55	22	-	-	-	43
Fat,	50	-	93	68	-	-	93	-
Protein,	54	-	42	79	-	-	89	75
Extract Matter,	56	-	59	69	-	-	93	91

Composition of Milk (Per Cent.).

Experiment I.

	Ada.		Red Spot.		Bessie.	
	Solids.	Fat.	Solids.	Fat.	Solids.	Fat.
Cotton-seed period,	13.84	4.93	14.01	4.84	13.63	4.93
	13.82	5.00	14.48	5.59	-	-
Average,	13.83	4.96	14.24	5.21	13.63	4.93
Hay period,	13.57	4.62	13.95	4.64	13.26	4.53
	-	-	-	-	13.47	4.52
Average,	13.57	4.62	13.95	4.64	13.36	4.52

Experiment I. — Concluded.

	Beauty.		Red.	
	Solids.	Fat.	Solids.	Fat.
Cotton-seed period, . .	15.08	5.62	14.03	5.05
	-	-	-	-
Average, . . .	15.08	5.62	14.03	5.05
Hay period, . . .	14.54	5.13	13.91	4.72
	14.61	5.05	13.87	4.60
Average, . . .	14.57	5.09	13.89	4.66

Experiment II.

	Mary.		Jennie.	
	Solids.	Fat.	Solids.	Fat.
Cotton-seed period, . .	13.96	4.64	14.36	4.73
	13.81	4.80	14.58	5.33
	14.20	4.93	14.58	4.92
	13.91	4.74	14.73	5.00
Average, . . .	13.97	4.74	14.56	5.00
Hay period, . . .	13.76	4.73	14.79	5.45
	13.86	4.75	15.39	5.88
	14.01	4.85	15.55	6.00
	13.85	4.68	15.37	5.78
Average, . . .	13.87	4.75	15.27	5.78

Experiment II. — Concluded.

	Beauty.		Red.		Spot.	
	Solids.	Fat.	Solids.	Fat.	Solids.	Fat.
Cotton-seed period,	14.62	5.35	12.48	3.89	14.57	5.08
	13.95	4.85	11.88	3.93	14.77	5.05
	14.66	5.48	12.60	4.02	14.92	5.15
	14.46	5.40	12.23	3.63	13.90	5.68
Average,	14.42	5.27	12.30	3.87	14.54	5.23
Hay period,	-	-	12.26	4.00	14.01	4.34
	14.12	4.93	12.41	4.05	14.14	4.75
	14.49	4.97	12.74	4.20	14.59	4.94
	14.19	4.80	12.53	4.08	14.94	4.91
Average,	14.27	4.90	12.49	4.08	14.42	4.73

Average Results of Six Cows.

	Experiment I.		Experiment II.	
	Solids.	Fat.	Solids.	Fat.
Cotton-seed period,	14.31	5.18	13.87	4.78
Hay period,	14.02	4.80	13.91	4.71

Each distinct analysis represents a composite sample from 8 different milkings. In Experiment I., samples were taken for four days of the last two weeks only. In Experiment II., each analysis represents the comparison of the milk for each of the four weeks.

REPORT OF THE ENTOMOLO

CHARLES H. FERNALD.

Two bulletins have been issued from this dep ing the year, — one on the habits, food and ec of the American toad (*Bufo lentiginosus ame* one on the brown-tail moth (*Euproctis chry* have been able in the intervals of other duties monograph of the plume-moths (*Pterophorid* America, which is published with illustrations fifth annual report of the college. A large am has also been devoted to the work on the gyps eastern part of the State.

SAN JOSÉ SCALE.

The San José scale (*Aspidiotus perniciosus*) in many places in Massachusetts, having bee nursery stock from nurseries both in this and in In the early part of the season my assistants as possible, all the nurseries in the State, and amined them for this scale. Most of them ap entirely free from this insect, but a few were infested. The owners of these infested nurseri the most active measures to destroy this pe supervision of one of my assistants. Many of men do not raise a sufficient amount of stock of their orders, and often purchase from out This stock is often received and sent out with tion, and in this way it is possible for the San be distributed by those whose nurseries are not bulletin on the San José scale will be publish other duties will permit, in which will be given plete account of the condition of the nurserie gether with the measures taken to eradicate the

The scale insects have been and are still being introduced o this country from other parts of the world, and in this y we are liable at any time to find new or unknown species our fruit or ornamental trees and shrubs and in our green- ises. It therefore seems wise to learn as much as possible out these insects, in order that we may know what to do h those already here, and any that may hereafter be ught into this country. To this end, more than six hun- d circular letters were sent out to all entomologists whose nes and addresses could be obtained, asking for specimens wo genera of the scale insects, and already a large amount material has been received. Prof. R. S. Lull has under- en to work up and prepare a monograph of the genus *lvinaria*, and Mr. R. A. Cooley a monograph of the genus *ionaspis*. Very commendable progress has already been de by these two gentlemen.

Army Worm.

During the summer of 1896 the army worm (*Leucania puncta*) was very abundant in Amherst and in many other ts of the State, often in destructive numbers, and in the respondence with this department information concerning insect was asked for more than of all others combined. ring the summer of 1897, however, the army worm seems have been present in so few numbers as to have done no m, and it was not referred to in a single letter received me. It is a well-known fact that this insect has never in past appeared in destructive numbers two years in suc- sion in the same place, and the past season seems to have n no exception. The caterpillars were reported in many es to have been more or less infested with the eggs of a asitic fly. These eggs no doubt hatched and the young ggots made their way into the caterpillars and destroyed m, thus reducing the army worm to insignificant numbers, that the few remaining have been entirely overlooked.

Plant Lice.

While the army worm has been very scarce during the past son, the aphids or plant lice have been very abundant on es and shrubs, and many letters have been received, asking

how to destroy them. The best method, so far as to spray the trees with kerosene emulsion; but it is very difficult to reach every insect, and, as the very rapidly, they soon become as abundant as e becomes necessary to spray the trees or shrubs after short intervals.

TOBACCO CUTWORM.

Early in the season cutworms were said to be the young tobacco plants in the tobacco fields o necticut valley, and specimens that were brought i to maturity developed into moths which proved *neades messoria*. The caterpillars of this species a rather varied diet, consisting not only of tobacc of cabbage, corn, potatoes, spinach, onions, l fruit trees. The usual method taken by our tobacc so far as I can learn, is to reset tobacco plants have been cut off by the worms, and at the sam out and destroy the worm that has done the misch

CANKER WORMS.

Four years ago canker worms began to increase in this town that public attention was called to t general account of the species occurring in Ma was given with illustrations in Bulletin No. 20, p January, 1893. In that bulletin the usual rem given. These consisted of tacking bands of he around the trunks of the trees and painting these prepared printers' ink, repainting with the ink as became dry or hardened enough to permit the cross the band. The method of protecting the tre troughs of zinc or tin around the trunks was also It was finally stated that probably the most effect was to spray the trees with Paris green in water the eggs hatched in the spring. A further accoun worms was given in Bulletin No. 28, published in A

A careful study of the different methods used these insects, which are so prevalent in many pa Commonwealth, has been made on thirteen apple t own premises in Amherst. Three years ago these

carefully banded with heavy paper and painted with Morrill's tree ink early in the spring, when the first females began to ascend the trees, and the painting was repeated as often as necessary. It was found that the ink would often harden on the trees even during the night following the application, and remain hard on the shady side long enough in the morning for some of the females to ascend the tree on that side, so that this method did not prove to be a perfect protection. The cost of the materials and of their application averaged about fifty cents to each tree.

The oil troughs are also quite expensive, and often leak so that the rain displaces the oil and then evaporates, allowing the females to ascend the trees; or spiders spin their webs across beneath the overhanging protection, forming a bridge on which the moths may easily pass, so that this device does not form a perfect protection.

Two years ago these trees were sprayed with Paris green in water, in the proportion of one pound to one hundred and fifty gallons, at a cost of five cents a tree, allowing fifteen cents an hour for labor. There was a strong wind blowing, and more time was required to do the work than would otherwise have been the case. Last year the same trees were sprayed with Paris green, in the same proportion as before. At this time it was nearly calm, and the cost of spraying was three cents a tree. The contrast between these trees and those on adjacent lots were very marked, for the sprayed trees retained their foliage and yielded a full crop, while the unsprayed trees were stripped of leaves, and bore no fruit. These trees were sprayed but once, and this method appears to have been more effectual and far cheaper than the others. In case of rain it might be necessary to repeat the spraying, but even then it would be the cheaper method.

REPORT OF THE CHEMIS

DEPARTMENT OF FERTILIZERS AND FE MATERIALS.

CHARLES A. GOESSMANN.
Assistants: HENRI D. HASKINS, CHARLES I. GOESSMAN LEAVENS.

I. Report on Official Inspection of Commercial Fe
II. Report on General Work in the Chemical Labo
III. Observations with Special Fertilizers on Toba Massachusetts.

I. REPORT ON OFFICIAL INSPECTION MERCIAL FERTILIZERS AND A URAL CHEMICALS IN 1897.

CHARLES A. GOESSMANN.

Sixty-six manufacturers and dealers in comm izers and agricultural chemicals have secured, past year, licenses for the sale of their goods i Thirty-six of these parties have offices for the tribution of their goods in Massachusetts; th reside in other States, — ten in New York, six cut, three in Rhode Island, three in Vermont, t sylvania, one in Maryland, one in Illinois, one three in Canada.

The number of distinct brands licensed, includi ural chemicals, amounted to two hundred and ni

The collecting and sampling of the material analyses were in charge of Mr. R. H. Smith, a

e Massachusetts Agricultural College in the class of 1892, 1o since his graduation has been an efficient assistant in e chemical laboratory of the experiment station for the amination of commercial fertilizers.

Four hundred and fifteen samples of fertilizer have thus : been collected during the present year; of these, three ndred and one samples, representing two hundred and enty-three distinct brands, were analyzed by the close of e month of November, and the results published in July d November bulletins, Nos. 48 and 49, of the Hatch Exriment Station of the Massachusetts Agricultural College. ie remaining samples, in common with others coming der our observation before the expiration of the licenses, ll be analyzed in due time, and the results published in nformity with our laws for the regulation of the trade in mmercial fertilizers.

The results of the inspection during the past season are, the whole, quite satisfactory, and if anything are an improvement on the results of the preceding year. The bencial results of improved machinery and of improved skill the management of the manufacture of fertilizers show emselves in a marked degree when compared with the genal character of commercial fertilizers in earlier periods of e business.

To render the actual conditions of the trade in commercial tilizers during the past season more prominent, a sumry of our results is here inserted. In reading the subseent statement, it has to be remembered that only the vest stated guarantee is legally binding in all sales: —

(*a*) Where three essential elements of plant food were guaranteed: —

mber with three elements equal to or above the highest guarantee,	3
mber with two elements above the highest guarantee,	2
mber with one element above the highest guarantee,	60
mber with three elements between the lowest and highest guarantee,	69
mber with two elements between the lowest and highest guarantees,	63
mber with one element between the lowest and highest guarantees,	16

Number with two elements below the lowest guarantee, .
Number with one element below the lowest guarantee, .

(*b*) Where two essential elements of plant feed were g
teed : —

Number with two elements above the highest guarantee,
Number with one element above the highest guarantee, .
Number with two elements between the lowest and highest g
tees, ...
Number with one element between the lowest and highest g
tees, ...
Number with one element below the lowest guarantee, .
Number with two elements below the lowest guarantee, .

(*c*) Where one essential element of plant food was g
teed : —

Number above the highest guarantee, ...
Number between the lowest and highest guarantees, .
Number below the lowest guarantee, ...

The modes of analyses adopted in this work w
essential points those recommended by the Asso
Official Chemists.

Attention has been called, in previous reports,
that the introduction of a more liberal amount of p
the make-up of a large class of so-called complet
has become from year to year more general. Th
has been slow but decided, and in a large degre
ascribed to the daily increasing evidence, resul
actual observations in field and garden, that the
of Massachusetts are frequently especially deficient
compounds, and consequently need in many instanc
liberal supply of available potash from outside
give satisfactory returns. Whenever garden vegetal
and forage crops constitute the principal produc
land, this recent change in the mode of manuring
particularly careful trial ; for the crops raised co
ceptionally large quantities of potash, as compared
crops. In view of these facts, it will be conced
system of manuring farm and garden which tend
the more satisfactory recognized conditions of la
of land, as well as the special wants of importan
branches of agricultural industries, is a moveme
right direction.

In repeating these statements, it is not assumed t

nain economical to continue the practice after a repeated plication of a liberal amount of potash, without some ecial reason.

To restore to the soil those essential manurial constitu-ts which the crops carry off is a safe rule to follow in the ort to secure the maintenance of the fertility of the soil; t to obtain this result in the most economical way will ways remain the ultimate aim of farming as a business terprise.

A judicious management of the trade in commercial fertil-rs implies a due recognition of results well established by periment, regarding the requirements of a remunerative oduction of farm and garden crops; yet, as the manufact-er at best can only prepare the composition of his special tilizers on general lines, not knowing the particular con-ion and character of the soil which ultimately receives em, it becomes of the utmost importance on the part of the mer to make himself acquainted with his special wants of nurial substances, and to thus qualify himself for a more dicious selection from the various fertilizers offered for rchase.

The present condition of the trade in commercial fertil-rs offers exceptional advantages to provide efficient nures for the raising of farm and garden crops of every scription congenial to soil and climate. The various es-ntial articles of plant food, as potash, phosphoric acid and trogen compounds, are freely offered for sale in forms itable to render, by their addition, the different kinds of nurial refuse matter of the farm in a higher degree fit meet the special wants of the crops to be raised.

As the physical conditions and chemical resources of soils available plant food frequently differ widely even on the me farm, no definite rule can be given for manuring farm nds, beyond the advice to return to the soil in available form ose plant constituents which the crops raised during the pre-ding years have abstracted in exceptionally large proportion, d which will be especially called for by the crops to be ised.

An intelligent selection of fertilizers from among the va-ous brands offered for sale requires, in the main, two kinds

of knowledge; namely, that the brand of fertiliz tion actually contains the guaranteed quantities ar of essential articles of plant food at a reasonabl that it contains them in such form and proporti best meet under existing circumstances the speci soil and crop.

In some cases it may be only phosphoric acid or potash; in others, two of them; and in other three. A remunerative use of commercial fert only be secured by attending carefully to these tions.

To assist farmers in selecting their fertilizers ence to the wants of the crops they wish to cu writer has for years published in his annual rep pilation of the analyses of farm and garden cro as a guide to all interested in a rational mode o plants. Copies of these compilations of analys secured by asking for them at the office of the Ha ment Station at Amherst, Mass.

An economical use of manurial substances from is only possible after the local condition of the consideration, as well as the special wants of the raised, have been duly considered. It becomes t of every progressive farmer to acquire such infor called for to select intelligently, from the variou resources at his disposal, those materials which best his wants for a complete fertilizer.

In making choice from among the so-called com izers, two points seem to be in particular worth re First, select them with reference to the amount, the the kind of essential constituents they are guaran tain, and not merely with reference to cost per ton; names are no guarantee of fitness. High-priced a offered by reputable manufacturers, have proved i stances cheaper than low-priced goods. Second supplies of reputable dealers, and insist in all case ment of guaranteed composition.

The majority of manufacturers and dealers in fertilizers in Massachusetts have been for years regarding the character of their goods, in the p

ports of the State inspector, which are open to the public; to these records this office invariably refers all parties asking for information in that direction.

Valuation of Commercial Fertilizers.

The market value of the higher grades of agricultural chemicals and compound fertilizers depends in the majority of cases on the amount and the particular form of three essential articles of plant food which they contain, *i.e.*, nitrogen, potash and phosphoric acid. Supply and demand control the temporary market prices not less in the fertilizer trade than in other lines of commercial business.

The approximate market value of a fertilizer, simple or compound, is obtained by multiplying the pounds contained in a ton of two thousand pounds by the trade value per pound of each of the three above-stated essential constituents of plant food present. The same course is adopted with reference to the different forms of each, wherever different prices are recognized in the trade. Adding the different values per ton obtained, we find the total value per ton at the principal place of distribution.

As farmers are quite frequently not in the position to secure the desired information regarding the market cost of fertilizers they wish to secure, the official inspectors of commercial fertilizers have aided them for years in ascertaining the current market prices of the following leading or standard raw materials: —

Sulphate of ammonia.	Ammoniate.
Nitrate of soda.	Castor pomace.
Muriate of potash.	Linseed meal.
Sulphate of potash.	Dried blood.
Cotton-seed meal.	Dried ground meat.
Dry ground fish.	Bone and tankage.
Azotin.	Plain superphosphates, etc.

Which serve largely in the manufacture of good fertilizers for our market; and have published the results of their inquiries in form of tables, stating the average trade values per pound, for the six months preceding, of the different kinds and forms of fertilizing materials at the leading places of distribution.

The market value of fertilizing ingredients, merchandise, is liable to changes during the se values stated below are based on the condition tilizer market in centres of distribution in Ne during the six months preceding March, 1897 : –

Trade Values of Fertilizing Ingredients in Raw M Chemicals, 1897 (Cents per Pound).

Nitrogen in ammonia salts, ...	
Nitrogen in nitrates, ...	
Organic nitrogen in dry and fine-ground fish, meat, blood high-grade mixed fertilizers, ...	
Organic nitrogen in cotton-seed meal, linseed meal and in pomace, ...	
Organic nitrogen in fine-ground bone and tankage, .	
Organic nitrogen in medium-ground bone and tankage,	
Organic nitrogen in coarse bone and tankage, . .	
Phosphoric acid soluble in water, ...	
Phosphoric acid soluble in ammonium citrate, . .	
Phosphoric acid in fine bone and tankage, . . .	
Phosphoric acid in medium bone and tankage, . .	
Phosphoric acid in coarse bone and tankage, . .	
Phosphoric acid in fine-ground fish, cotton-seed meal, li meal, castor pomace and wood ashes, . . .	
Phosphoric acid insoluble (in am. cit.) in mixed fertilizers,	
Potash as sulphate, free from chlorides, . . .	
Potash as muriate, ...	

From these figures it is apparent that the bes nitrogen and phosphoric acid have suffered a mat tion in cost, as compared with preceding years.

The market value of low-priced materials used rial purposes, as salt, wood ashes, various kin barn-yard manure, factory refuse and waste m various description, quite frequently does not close relation to the current market value of the essential articles of plant food they contain. varies in different localities. Local facilities for c portation, and more or less advantageous mecha tions for speedy action, exert, as a rule, a decide on their selling price.

The mechanical condition of any fertilizing mate or compound, deserves the most serious consid farmers when articles of a similar chemical ch

offered for their choice. The degree of pulverization controls, almost without exception, under similar conditions, the rate of solubility, and the more or less rapid diffusion of the different articles of plant food throughout the soil.

The state of moisture exerts a no less important influence on the pecuniary value in case of one and the same kind of substance. Two samples of fish fertilizers, although equally pure, may differ from fifty to one hundred per cent. in commercial value, on account of mere difference in moisture.

Crude stock for the manufacture of fertilizers, and refuse materials of various descriptions, have to be valued with reference to the market price of their principal constituents, taking into consideration at the same time their general fitness for speedy action.

Consumers of commercial manurial substances will do well to buy, whenever practicable, on a guarantee of composition of their essential constituents, and to see to it that the bill of sale recognizes the point of the bargain. Any mistake or misunderstanding in the transaction may be readily adjusted, in that case, between the contending parties. The responsibility of the dealer ends with furnishing an article corresponding in its composition with the lowest stated quantity of each specified essential constituent.

It is of the first importance, when buying fertilizers for home consumption, to consider their cost with reference to what they promise to furnish.

List of Manufacturers and Dealers who have secured Certificates for the sale of Commercial Fertilizers in the State during the Past Year (May 1, 1897, to May 1, 1898) and the Brands licensed by Each.

The Armour Fertilizer Works, Chicago, Ill.: —
- Bone Meal.
- Bone and Blood.
- Ammoniated Bone and Potash.
- All Soluble.
- Bone, Blood and Potash.
- Grain Grower.

American Fertilizer Co., Boston, Mass.: —
- Alkali Nitrate Phosphate for Hoed Crops.

American Fertilizer Co. — *Con.*
- Alkali Nitrate Phosphate for Grass and Grain.
- General American Fertilizer.
- Potato Fertilizer.

Wm. H. Abbott, Holyoke, Mass.: —
- Eagle Brand for Grass and Grain.
- Complete Tobacco Fertilizer.
- Animal Fertilizer.

American Cotton Oil Co., New York, N. Y.: —
- Cotton-seed Meal.

Bartlett & Holmes, Springfield, Mass.: —
Pure Ground Bone.
Animal Fertilizer.
Tankage.

H. J. Baker & Bro., New York, N. Y.: —
Pure Ground Bone.
Standard Un X Ld Fertilizer.
Strawberry Manure.
Potato Manure.
Tobacco Manure.
Grass and Grain Manure.
A. A. Ammoniated Superphosphate.
Harvest Home Fertilizer.

C. A. Bartlett, Worcester, Mass.: —
Fine-ground Bone.
Animal Fertilizer.

Berkshire Mills Co., Bridgeport, Conn.: —
Complete Fertilizers.
Ammoniated Bone Phosphate.

Bowker Fertilizer Co., Boston, Mass.: —
Stockbridge Special Manures.
Hill and Drill Phosphate.
Farm and Garden Phosphate.
Lawn and Garden Dressing.
Fish and Potash.
Potato and Vegetable Manure.
Potato Phosphate.
Market Garden Manure.
Sure Crop Phosphate.
Gloucester Fish and Potash.
High-grade Fertilizer.
Essex Fertilizer.
Bone and Wood Ash Fertilizer.
Nitrate of Soda.
Dried Blood.
Dissolved Bone-black.
Muriate of Potash.
Sulphate of Potash.

William E. Brightman, Tiverton, R.I.: —
Potato and Root Manure.
Phosphate.
Fish and Potash.

Bradley Fertilizer Co., Boston, Mass.: —
X. L. Superphosphate.
Potato Manure.
B. D. Sea Fowl Guano.
Complete Manures.
Fish and Potash.
High-grade Tobacco Manure.
English Lawn Fertilizer.
Ammoniated Bone Phosphate.
Breck's Lawn and Garden Dressing.
Sulphate of Potash.

Bradley Fertilizer Co. —
Muriate of Potash.
Nitrate of Soda.
Sulphate of Ammon
Dissolved Bone-blac
Fine-ground Bone.

Daniel T. Church, Provi
Wilcox, general agent
Church's B Special.
Church's C Standar
Church's D Fish an

The Cleveland Linseed
land, O.: —
Screened Linseed M

Clark's Cove Fertilize
Mass.: —
Bay State Fertilizer.
Bay State Fertilizer
Great Planet Manur
Potato and Tobacco
King Philip Guano.
Potato Manure.
Fish and Potash.
White Oak Pure Bo

Cleveland Dryer Co., B
Superphosphate.
Potato Phosphate.
Cleveland Fertilizer

E. Frank Coe Co., New
High-grade Potato
Bay State Ammonia
phosphate.
Bay State Potato M
High-grade Ammo
perphosphate.
Gold Brand Excels
Fish Guano and Po

Crocker Fertilizer and
Buffalo, N. Y.: —
Ammoniated Bone
Potato, Hop and Tob
Ammoniated Wheat
phate.
New Rival Ammoni
phate.
Practical Ammonia
phate.
Vegetable Bone Sup
General Crop Phosp
Universal Grain Gr
Special Potato Man
New England Tob
Grower.

Crocker Fertilizer and Chemical Co. — *Con.*
Coolidge Bros. Special Truck Fertilizer.
A. A. Complete Manure.
Ground Bone Meal.
Pure Ground Bone.
Muriate of Potash.
Nitrate of Soda.

Cumberland Bone Phosphate Co., Boston, Mass.: —
Superphosphate.
Potato Fertilizer.
Concentrated Phosphate.
Guano.

City Florist, Brockton, Mass.: —
Boo Boo Plant Food.

L. B. Darling Fertilizer Co., Pawtucket, R. I.: —
Animal Fertilizer.
Potato and Root Crop Manure.
Lawn Dressing.
Tobacco Grower.
Blood, Bone and Potash.
Special Formula.
Fine-ground Bone.
Muriate of Potash.
Nitrate of Soda.

John C. Dow & Co., Boston, Mass.: —
Ground Bone Fertilizer.
Nitrogenous Superphosphate.
Pure Ground Bone.

W. E. Fife & Co., Clinton, Mass.: —
Wood Ashes.

Great Eastern Fertilizer Co., Rutland, Vt.: —
Northern Corn Special.
General Fertilizer.
Vegetable Vine and Tobacco Fertilizer.
Garden Special.
Soluble Bone and Potash.

Thomas Hersom & Co., New Bedford, Mass.: —
Bone Meal.
Meat and Bone.

Alonzo P. Henderson, Hanover, Mass.: —
Acme Brand Fertilizer.

Edmund Hersey, Hingham, Mass.: —
Ground Bone.

John G. Jefferds, Worcester, Mass.: —
Animal Fertilizer.
Potato Manure.
Fine-ground Bone.

Thomas Joint, St. Helen, Ontario, Can.: —
Unleached Hard-wood Ashes.

Thomas Kirley, South Hadley Falls, Mass.: —
Pride of the Valley.

A. Lee & Co., Lawrence, Mass.: —
Lawrence Fertilizer.

Lowell Fertilizer Co., Boston, Mass.: —
Bone Fertilizer for Corn and Grain.
Complete Manure for Vegetables.
Animal Fertilizer.
Potato Phosphate.
Bone and Potash.
Lawn Dressing.
Tobacco Manure.
Empire Fertilizer.

Lowe Bros. & Co., Fitchburg, Mass.: —
Tankage.

F. L. Lalor, Dunville, Ontario, Can.: —
Canada Unleached Hard-wood Ashes.

The Mapes Formula and Peruvian Guano Co., New York, N. Y.: —
Bone Manures.
Superphosphates.
Special Crop Manures.
Sulphate of Potash.
Double Manure Salts.
Nitrate of Soda.

E. McGarvey & Co., London, Ontario, Can.: —
Unleached Hard-wood Ashes.

McQuade Bros., West Auburn Mass.: —
Fine-ground Bone.

Geo. L. Monroe, Oswego, N. Y.: —
Canada Unleached Hard-wood Ashes.

National Fertilizer Co., Bridgeport, Conn.: —
Complete Fertilizers.
Ammoniated Bone.

National Fertilizer Co. — *Con.*
Market-garden Manure.
Potato Phosphate.
Fish and Potash.
Ground Bone.

Niagara Fertilizer Works, Buffalo, N. Y.: —
Wheat and Corn Producer.
Grain and Grass Grower.
Potato, Tobacco and Hop Fertilizer.
Niagara Triumph.

New England Dressed Meat and Wool Co., Boston, Mass.: —
Sheep Fertilizer.

Packers Union Fertilizer Co., New York, N. Y.: —
Universal Fertilizer.
Wheat, Oats and Clover Fertilizer.
Animal Corn Fertilizer.
Potato Manure.
Gardener's Complete Manure.

Pacific Guano Co., Boston, Mass : —
Soluble Pacific Guano.
Special Potato Manure.
Special for Potatoes and Tobacco.
Nobsque Guano.
High-grade General Fertilizer.

Parmenter & Polsey Fertilizer Co., Peabody, Mass.: —
Plymouth Rock Brand.
Star Brand Fertilizer.
Butman Brand Fertilizer.
Special Potato.
Strawberry.
Ground Bone.
Muriate of Potash.
Sulphate of Potash.
Nitrate of Soda.

A. W. Perkins & Co., Rutland, Vt.: —
Plantene.

Prentiss, Brooks & Co., Holyoke, Mass.: —
Complete Manures.
Phosphate.
Nitrate of Soda.
Muriate of Potash.
Sulphate of Potash.

Preston Fertilizer Co., Brooklyn, N. Y.: —
Ammoniated Bone Superphosphate.

Quinnipiac Co., Bosto
Phosphate.
Potato Manure.
Market-garden M
Fish and Potash.
Havana Tobacco
Grass Fertilizer.
Corn Manure.
Potato Phosphate.
Onion Manure.
Pure Ground Bon
Dry Ground Fish.
Muriate of Potash
Sulphate of Potas
Nitrate of Soda.
Sulphate of Amm
Dissolved Bone-bl

Read Fertilizer Co.,
(H. D. Foster, gene
Standard Fertilize
High-grade Farme
Practical Potato S
Farmer's Friend,
Vegetable and Vi

N. Roy & Son, Sou
Mass.: —
Complete Animal

The Rogers & Hubbard
Conn.: —
Soluble Potato M
Soluble Tobacco
Fairchild's Form
General Crops.
Fruit Fertilizer.
Grass and Grain F
Oats and Top-dres
Pure Raw Knuckl
Strictly Pure Fine
Fertilizer for all S

Russia Cement Co., Gl
X X X Fish and P
High-grade Superp
Corn, Grain and G
Potato, Root and V
Special Tobacco F
Odorless Lawn Dr

Lucien Sanderson, New
Formula A.
Blood, Bone and M
Dissolved Bone-bla
Nitrate of Soda.
Sulphate of Potash
Muriate of Potash.

Edward H. Smith, Northborough, Mass.: —
Ground Bone.

J. Stroup & Son Co., Boston, Mass.: —
Hard-wood Ashes.

Thomas L. Stetson, Randolph, Mass.:—
Ground Bone.

Standard Fertilizer Co., Boston, Mass.:—
Standard Fertilizer.
Potato and Tobacco Fertilizer.
Standard Guano.
Complete Manure.
Fine-ground Bone.

C. F. Sturtevant, Hartford, Conn: —
Tobacco and Sulphur Fertilizer.

Henry F. Tucker, Boston, Mass.: —
Original Bay State Bone Superphosphate.
Imperial Bone Superphosphate.
Special Potato Fertilizer.

I. P. Thomas & Son Co., Philadelphia, Pa.: —
Martin's Bone Mixture.
So. Carolina Phosphate with Potash.
So. Carolina Phosphate.
Pure Ground Animal Bone.
Steamed Bone.
Improved Superphosphate.
Potato and Tomato Manure.
Normal Bone Phosphate.
Farmer's Choice Bone Phosphate.
Tobacco Fertilizer.

Walker, Stratman & Co., Pittsburg, Pa.: —
Potato Special.
Big Bonanza.
Smoky City.
Four Fold.

Andrew H. Ward, Boston, Mass.: —
Ward's Chemical Fertilizer.

I. S. Whittemore, Wayland, Mass.: —
Complete Manure.

D. Whithed, Lowell, Mass.: —
Champion Fertilizer.
Bone Meal.

The Wilcox Fertilizer Works, Mystic Conn.: —
Potato, Onion and Tobacco Manure.
Ammoniated Bone Phosphate.
High-grade Fish and Potash.
Dry Ground Fish Guano.

Williams & Clark Fertilizer Co., Boston, Mass.: —
Ammoniated Bone Superphosphate.
Potato Phosphate.
High-grade Special.
Fine Wrapper Tobacco Grower.
Royal Bone Phosphate.
Corn Phosphate.
Potato and Tobacco Manure.
Grass Manure.
Fish and Potash.
Universal Ammoniated Dissolved Bone.
Prolific Crop Producer.
Onion Manure.
Bone Meal.
Dry Ground Fish.
Sulphate of Potash.
Muriate of Potash.
Nitrate of Soda.
Dissolved Bone-black.
Sulphate of Ammonia.

M. E. Wheeler & Co., Rutland, Vt.: —
High-grade Corn Fertilizer.
High-grade Potato Manure.
Superior Truck Fertilizer.
Havana Tobacco Grower.
High-grade Fruit Fertilizer.
High-grade Grass and Oats Fertilizer.
Electrical Dissolved Bone.

II. REPORT ON GENERAL WORK IN T ICAL LABORATORY.

CHARLES A. GOESSMANN.

1. Analyses of Materials sent on for Examina
2. Notes on Barn-yard Manure.
3. Notes on Wood Ashes.
4. Notes on Cotton-seed Meal.
5. Notes on Guano from West Coast of Afric
6. Notes on Ashes from Crematory Furnace Garbage.
7. Notes on Wool Washings.

1. Analyses of Materials sent on for E

The work carried on in this connection is g year to year in importance. A large proport mercial manurial substances consists of by or w of various industries. The composition and ge ter of these materials depend on the current m facture. The rapid advancement in many branc tries is at any time liable to affect more or less commercial as well as the manurial value of thei ucts. A frequent examination of that class cannot fail to benefit the vital interests of our munity. For this reason arrangements were previous years, to attend to the examination of interest to farmers to the full extent of placed at the disposal of the officer in charge These investigations are carried on free of char of the State. The results are considered pub and are published from time to time in the bu station.

The number of substances tested in this conne to two hundred and thirty-eight. As the detail

analyses have already been published in three bulletins, 45, 48 and 49, March, July and November, 1897, a brief nent of the names of the different articles analyzed will, is occasion, suffice to convey some idea of the extent he character of the work accomplished. Only a few of materials of more special importance are reserved for a quent short discussion.

e substances tested from Dec. 1, 1897, to Dec. 1, 1898, s follows: wood ashes, 89; cotton-seed meal, 23; cot-eed hull ashes, 3; cotton factory waste, 5; tankage, and fish, 17; muck, peat and soils, 16; chemicals, 14; phosphates and dissolved bone-blacks. 5; natural phos-s, 6; tobacco refuse, 2; complete fertilizers, 31; mis-neous, 9; Damara land guano, garbage cremation ashes vool washings, each 1.

ide from this work are the complete analyses of 36 les of tobacco leaves, together with numerous tests he quality of ash and rate of combustion. See Bul-No. 47, on tobacco experiments, published in April, .

e responsibility of the genuineness of all articles sent or examination rests with the parties asking for the sis. Our publications of the results refer merely to ocality they come from, to avoid misunderstandings. les of fertilizers collected from original packages by rized agents of the station in the general markets fur-the material for official analyses, and are considered ine articles.

2. Notes on Barn-yard Manure.

e importance of barn-yard manure as a home source of food cannot be over-estimated in a mixed farm man-ent. In a well-regulated rational system of stock feed-t is one of the cheapest if not the cheapest source of able manurial constituents. An exceptional liability to in composition is the strongest objection which can be d against its exclusive use as a manure supply for the and garden, yet this objection has lost much of its force the causes of variation are better understood, and may be avoided to a considerable extent. We have learned

how to improve its efficiency as a complete manure under varying conditions of soil as well as of varying wants of crops, by adding those manurial constituents which are called for in different relative proportions, and which the barn-yard manure on hand does not contain.

Analyses of Eighty Samples of Barn-yard Manure made at Amherst, Mass.

ANALYSIS.	POUNDS PER HUNDRED.			Pounds per Ton (2,000 Pounds).
	Highest.	Lowest.	Average.	
Moisture,	75.00	60.00	67.24	1344.80
Nitrogen,	1.36	.21	.52	10.40
Potassium oxide,	1.40	.13	.56	11.20
Phosphoric acid,	.75	.10	.39	7.80

The average barn-yard manure contains, as will be noticed from the above statement, a larger percentage of nitrogen as compared with potash and phosphoric acid than is generally considered economical in a complete fertilizer for general farm purposes.

The practice of adding to the manurial refuse materials of the farm, as stable manure, vegetable compost, etc., such single commercial manurial substances as will enrich them in the direction desirable for any particular crop, does not yet receive that degree of general attention which it deserves. An addition of potash in the form of muriate or sulphate of potash, or of phosphoric acid in the form of fine-ground South Carolina or Florida soft phosphate, etc., will in many instances not only improve their general fitness as complete manure, but quite frequently permit a material reduction in the amount of barn-yard manure ordinarily considered necessary to secure satisfactory results. An addition of from thirty to forty pounds of muriate of potash and one hundred pounds of fine-ground soft Florida phosphate per ton of barn-yard manure, at any time before applying the latter to the soil deserves recommendation.

3. Notes on Wood Ashes.

Forty per cent. of all articles sent on for examination nsist of wood ashes. They are sold in the majority of es under the trade name "Unleached Canada hard-wood es." Ninety-eight samples tested at the station during past year gave the following results: —

	No. of Samples.
Moisture from 1 to 3 per cent.,	10
" 4 to 6 "	8
" 6 to 10 "	13
" 10 to 15 "	19
" 15 to 20 "	11
" 20 to 30 "	10
Moisture above 35 per cent.,	1
Potassium oxide above 8 per cent.,	3
" " from 7 to 8 per cent.,	8
" " " 6 to 7 "	21
" " " 5 to 6 "	28
" " " 4 to 5 "	10
" " " 3 to 4 "	3
" " below 3 per cent.,	none
Phosphoric acid above 2 "	4
" " from 1 to 2 per cent.,	45
" " below 1 per cent.,	24
Average per cent. of calcium oxide (lime),	34.29
Per cent. mineral matter insoluble in diluted hydrochloric acid, from — 6 to 10,	10
10 to 15,	30
15 to 20,	15
20 to 30,	3
above 30,	1

The variations noticeable in the composition of wood es are not surprising when we consider the crude mode collecting and handling them for commercial purposes. particular effects of both varying quantities of foreign oluble matter, as soil, coal ashes, etc., and of moisture, the composition of a given sample of genuine wood es, as far as its percentage of potash and of phosphoric l is concerned, depend largely on the particular kind of od which has served for the production of the ash. The or of the wood ashes in case of dark varieties depends ally on admixture of more or less charcoal, while an ex-tionally light color is not unfrequently due to the kind wood which furnishes it. Some kinds of wood, as elm

wood, produce a white ash of excellent qual from samples sent on for examination.

As the dealer is only obliged to guarantee th potash and of phosphoric acid present in a gi of wood ashes, no serious objection can be raise of the buyer on account of moisture, etc., as article contains the specified amount of both phosphoric acid.

Wood ashes ought to be bought and sold by not by measure, for both moisture and foreign apt to affect seriously the weight of a given mea

Some dealers in wood ashes have adopted of tice of stating merely the sum of both, instead the amount of each of them present. As pho and potassium oxide contained in wood ashes a in our section of the country, pound for pound commercial value, from 4.5 to 5 cents, no par tion can be raised against a joint statement of the mere money value of the samples is conce this mode of stating the guaranteed compositi lead to misconception and abuse, it ought to be and discontinued.

The large percentage of lime, from 30 to found in genuine wood ashes, imparts a specia value to them as a fertilizer, aside from th potash and phosphoric acid they contain. application of lime is desired, wood ashes dese consideration, on account of the superior me dition of the lime they furnish.

4. Notes on Cotton-seed Meal as a F

Recent low prices of some concentrated fee favored experiments to test their fitness fo directly nitrogen, phosphoric acid and potash fo Whenever the market value of the amount phosphoric acid and potash they contain co well with the market cost of these three ing trials deserve, for various reasons, encourageme

The richness of cotten-seed meal, linseed well as their marked disposition to rot in the

oisture and of a fair average temperature, caused their lection. Both are quite frequently looked upon with favor suitable materials to furnish plant food for various farm ops. Cotton-seed meal in particular is to-day used extenvely by tobacco growers in the Connecticut River valley the main source of nitrogen for that crop.

The increasing importance of cotton-seed meal as a fertiler has been followed by the writer with a frequent exnination of the articles sold in our markets to protect the terests of our farmers. Importers of cotton-seed meal, aiming that they sold their articles as a feed stuff and not a fertilizer, declined as a rule until quite recently to take it a fertilizer license which would oblige them to sell with stated guarantee of at least the nitrogen.

The results of sixty-five analyses carried on under my rection are as follows: —

	Per Cent.		
	Maximum.	Minimum.	Average.
oisture,	10.80	3.90	7.00
trogen,	7.95	2.08	6.60
osphoric acid,	3.36	.73	1.79
tassium oxide,	2.38	.48	1.76

Allowing 12 cents for every pound of nitrogen, 5 cents r pound for each of phosphoric acid and potassium oxide, ese three ingredients represent per ton a market value of —

$19.39 in case of our average sample of cotton-seed meal.
24.82 in case of our highest sample of cotton-seed meal.
6.20 in case of our lowest sample of cotton-seed meal.

The above-stated difference in the composition of cottoned meal is mainly due to the presence of more or less ound skins and husks of the cotton seed. Cotton-seed eal designed for fodder ought to be free from skins and isks, to deserve a recommendation for that purpose; cotn-seed meal to be used for fertilizer may contain more or

less of this substance, provided the entire mate
ground and the price in accordance with the com
We advise farmers to buy cotton-seed meal, l
fertilizing materials, on the basis of a guarantee
nitrogen as the basis of the bargain. For their
it seems but proper to state in this connecti
American Cotton Oil Company of New York h
cently secured a license for the sale of their cott
as a fertilizer in our State, and intend to sell on
the amount of nitrogen their article contains.

5. Notes on Damara Land Guan

The material which served for our examinati
on to this office by Messrs. H. J. Baker & Bro. o
City. It consisted of a bag containing two hun
of guano, and was accompanied by analyses of t
of London, Eng. As every new source of a ge
claiming to resemble the Peruvian guano of ea
in the trade of commercial fertilizers must be o
portance to all interested in the temporary reso
supplies of plant food, our results are briefly stat

Analysis of Damara Land Guano (Per Cen

Moisture at 100° C.,	
Organic matter,	
Total ash,	
Total nitrogen,	
Nitrogen in form of ammoniates,	
Nitrogen in form of nitrates,	
Nitrogen in form of organic matter,	
Carbonic acid,	
Total phosphoric acid,	
Soluble phosphoric acid,	
Reverted phosphoric acid,	
Insoluble phosphoric acid,	
Total potassium oxide,	
Potassium oxide soluble in water,	
Sodium oxide,	
Calcium oxide,	
Magnesium oxide,	
Iron and aluminum oxides,	
Sulphuric acid,	
Chlorine,	
Insoluble matter,	

results of our analyses of the sample (two hundred bag) kindly sent on for trial by Messrs. H. J. Baker ., New York City, are fairly within the stated comon of English chemists. The guano, it is stated, has brought from some islands off the west coast of Africa; valuable material, as may be seen from our detailed ent.

Notes on Crematory Ashes from City Garbage.

ny annual report for 1895 (pages 160 and 161), special ion was called to two important recent modes of savty garbage, kitchen refuse in particular, for manurial ses. Sanitary considerations are the first cause of troduction of these new modes of disposing of objecle refuse matter, which promise to become from day y more important as supplies of valuable fertilizer ials.

attention has been in particular called to the products crematory furnace ashes from Lowell, Mass. The is evidently improving, in consequence of the adopf a proper system of sifting and grinding the ashes, be seen from the accompanying analysis, representccording to statement, one hundred tons. The selling from $10 to $11 per ton, invites serious trials, as a zer furnishing potash, phosphoric acid and lime.

lysis of Ashes from the Cremation of City Garbage (Per Cent.).

Moisture at 100° C.,	.53
Potassium oxide,	6.01
Sodium oxide,	15.65
Total phosphoric acid,	10.21
Available phosphoric acid,	2.34
Insoluble phosphoric acid,	7.87
Sulphuric acid (So_3),	4.57
Chlorine,	4.75
Carbonic acid (CO_2),	10.85
Calcium oxide,	20.22
Magnesium oxide,	1.16
Iron and alumina,	9.32
Insoluble matter,	24.26
Nitrogen (inactive lyan compounds),	.17

7. Notes on Wool Washings as a Source of Fertilizer.

It is a well-known fact that the skins of sheep and raw wool are coated with potash compounds of a soap-like nature. In many localities in Europe it is a common practice to turn to account for manuring grass lands the water used in washing sheep before shearing, as well as the wash water obtained from raw wool in factories. This is used in form of an overflow. Wherever meadows adjoin the place of washing wool, arrangements may be readily provided for turning the wool washings directly to account. Samples of raw wool tested here for potash some years ago gave the following results: —

Potassium oxide soluble in water (per cent.),	3.92
Potassium oxide soluble in diluted hydrochloric acid (per cent.),	4.20

Of interest in this connection are the results of examination of a material sent on from a factory in this State. The article was labelled "concentrated potash liquor," and described as obtained from the washings of wool with water after the grease had been extracted by naphtha. It consisted of a highly colored, thick, syrup-like mass, containing a liberal admixture of fine fibrous vegetable matter. An analysis made with reference to its approximate value as a fertilizer gave the following results: —

	Per Cent.
Moisture at 100° C.,	41.13
Dry matter,	58.87

The dry matter left behind contained: —

	Per Cent.
Potassium oxide,	10.15
Phosphoric acid,	.10
Nitrogen,	1.09

The commercial value of these ingredients per ton of the original substance at the present rates amounts approximately to $12.40. In charring the original material directly, 100 parts left behind 36.49 parts; the charred mass tested for potassium oxide showed 34.91 per cent. present, or 698.2 pounds of potassium oxide per ton of charred residue, which

equals 1,012 pounds of carbonate of potash per ton of charred residue practically free from chlorine.

The scarcity of a good quality of carbonate of potash for manurial purposes in case of tobacco and similar industrial crops ought to encourage attempts to turn the concentrated potash liquor to account.

The charred mass might serve directly as material for the manufacture of a high-grade potash fertilizer.

III. NOTES OF FIELD EXPERIMEN TOBACCO IN MASSACHUSETTS, 18

CHARLES A. GOESSMANN.

The experiments briefly described in the foll were carried on with the co-operation of the Val Experiment Association of Massachusetts.

The officers of this organization consisted c L. A. Crafts of Whately, Vice-President C. L Westfield, Secretary and Treasurer G. D. Fisk c Board of Directors, W. A. Porter of Agawam Warner of Hatfield.

Hatfield, Westfield and Agawam were chosen tion of the experiments. The selection of th field in each place was left to a special comm association. In all cases a deep, sandy loam for the trial.

The same kind and the same amount of fe gredients were used in all cases, and the obser tinued for three successive years. For details No. 47, April, 1897.

The variety of tobacco selected for the trial seed. For the purpose of securing uniformity during the years of the experiment, it was dec chase at once, as far as advisable, enough of e supply the needed materials for three years.

Statement of Fertilizers used upon Differ

The fertilizer mixture used during the ent observation contained in all cases, per acre : —

Potassium oxide (available)	.
Nitrogen (available), ...	.
Phosphoric acid (available), ...	.

One-fourth of the nitrogen was in all cases form of nitrates of soda or potash, to secure a u

dition of availability of nitrogen during the early stages of growth.

Each experiment plot measured 3,634 square feet, or approximately one-twelfth of one acre.

Chemical Composition of the Different Fertilizing Ingredients used in compounding the Special Fertilizers for Different Plots in the Tobacco Experiment. Ingredients containing Chlorine were carefully excluded from the Mixtures of Fertilizers in All Cases.

NAME OF MATERIAL.	Nitrogen.	Phosphoric Acid.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.
Nitrate of soda, ...	15.59	-	-	35.00	-	-
Nitrate of potash, ...	12.79	-	45.05	-	-	-
Cotton-seed meal, ...	6.50	3.17	2.25	-	-*	-*
Linseed meal, ...	5.91	1.95	1.08	-	-*	-*
Castor pomace, ...	5.60	2.26	3.40	-	-*	-*
Dissolved bone-black, ...	-	13.38	-	-	-*	-
Odorless phosphate, or phosphatic slag,	-	18.42	-	-	48.27	-
High-grade sulphate of potash, . .	-	-	50.20	-	-	-
Potash-magnesia sulphate, ...	-	-	24.32	-	-	12.58
Cotton-seed hull ashes, ...	-	7.93	23.96	-	9.30	10.47
Carbonate of potash-magnesia, . .	-	-	18.48	-	-	19.52
Barn-yard manure, ...	.52	.39	.56	-*	-*	-*

* Not determined.

Chemical Composition of the Different Special Formulas used in the Tobacco Experiment.

PLOT 1.

NAME OF FERTILIZING MATERIAL USED.	Pounds per Acre.	POUNDS OF FERTILIZING ELEMENTS PER ACRE. Phosphoric Acid.	Potassium Oxide.	Nitrogen.
Nitrate of potash, ...	195	-	88	25
Cotton-seed meal, ...	1,154	37	26	75
Dissolved bone-black, ...	175	23	-	-
Potash-magnesia sulphate, . .	765	-	186	-
Total, ...	-	60	300	100

PLOT 2.

NAME OF FERTILIZING MATERIAL USED.	Pounds per Acre.	POUNDS OF FE… PE…	
		Phosphoric Acid.	Po…
Nitrate of potash, ...	195	–	
Castor pomace, ...	1,340	31	
Dissolved bone-black, . . .	221	29	
Potash-magnesia sulphate, . .	685	–	
Total, ...	–	60	

PLOT 3.

Nitrate of soda, ...	160.3	–	
Cotton-seed meal, ...	1,154.0	37.00	
Cotton-seed hull ashes, . . .	1,142.0	90.56	
Total, ...	–	127.56	

PLOT 4.

Nitrate of soda, ...	160.3	–	
Castor pomace, ...	1,340.0	31.0	
Cotton-seed hull ashes, . . .	1,060.0	84.1	2…
Total, ...	–	115.1	2…

[PLOT 5.—No manure at any time during the exp

PLOT 6.

Nitrate of soda, ...	160.3	–	
Cotton-seed meal, ...	1,154.0	37	
Dissolved bone-black, . . .	175.0	23	
High-grade sulphate of potash, .	545.8	–	
Total, ...	–	60	

PLOT 7.

[cut off]E OF FERTILIZING MATERIAL USED.	Pounds per Acre.	Pounds of Fertilizing Elements per Acre. Phosphoric Acid.	Potassium Oxide.	Nitrogen.
[cut off] of soda,	160.3	-	-	25
[cut off] pomace,	1,340.0	31	45.50	75
[cut off]ed bone-black,	221.0	29	-	-
[cut off]rade sulphate of potash,	506.0	-	254.50	-
[cut off]tal,	-	60	300.00	100

PLOT 8.

[cut off] of soda,	160.3	-	-	25
[cut off]l meal,	1,271.0	24.78	14	75
[cut off]ed bone-black,	263.0	35.22	-	-
[cut off]rade sulphate of potash,	569.7	-	286	-
[cut off]tal,	-	60.00	300	100

PLOT 9.

[cut off] of potash,	195	-	88	25
[cut off]-seed meal,	1,154	37	26	75
[cut off]-seed hull ashes,	776	62	186	-
[cut off]tal,	-	99	300	100

PLOT 10.

[cut off] of potash,	195.0	-	88.00	25
[cut off] pomace,	1,340.0	31	45.50	75
[cut off]atic slag meal,	157.0	29	-	-
[cut off]ate of potash-magnesia,	900.9	-	166.50	-
[cut off]tal,	-	60	300.00	100

PLOTS 11 AND 12.*

[cut off]ard manure,	20,000	78	112	104

[cut off]e analysis of seventy-five samples tested at the station laboratory at Amherst, Mass.

SUMMARY OF THREE YEARS OF OBSERVATION AT AGAWAM AND WESTFIELD.

I. Number of Plants harvested and Yield of Tob Thousand Plants.

Hatfield (Old Tobacco Land).

YEAR.	AVERAGE NUMBER OF PLANTS.		DIFF PE BA (Po
	Per Plot.*	Per Acre.	Hi
1893, ...	561	6,734	
1894, ...	618	7,419	
1895, ...	626	7,512	

* One-twelfth of one acre.

Westfield (New Tobacco Land).

1894, ...	670	8,040	
1895, ...	593	7,122	
1896, ...	689	8,269	

Agawam (New Tobacco Land).

1893, ...	696	8,352	
1894, ...	704	8,432	
1895, ...	695	8,340	

YEAR.	AVERAGE YIELD OF TOB OF 1,000 PLANTS HARV	
	Hatfield.	Westfiel
1893, ...	235.2	–
1894, ...	206.4	171.
1895, ...	210.5	228.
1896, ...	–	199.

lverage Yield of Tobacco, with Reference to Wrapper, per One Thousand Plants.

Hatfield.

YEAR.	Average Yield of Tobacco.	Average Yield of Wrappers.	Average Percentage of Wrappers.	Variations in Percentage of Wrappers in Plots.
	Pounds.	Pounds.		
. . . .	235.2	97.2	41.2	21.0-71.0
. . . .	206.6	105.0	50.7	38.8-64.4
. . . .	210.1	109.3	52.1	36.8-63.1
Westfield.				
. . . .	171.3	90.3	52.3	41.6-62.10
. . . .	228.7	49.6	21.2	6.4-34.40
. . . .	199.3	138.2	69.6	59.0-78.80
Agawam.				
. . . .	190.8	-*	-*	-*
. . . .	191.7	52.2	26.7	8.8-44.4
. . . .	178.8	-*	-*	-*

* Not determined.

LUSIONS DRAWN FROM THE THIRD YEAR OF OBSERVATION.

Good mechanical preparation of the soil and early cation, and thus good diffusion of the fertilizers, not less early planting and a suitable number of plants to a area, exert a decided influence on the quantity and the y of the crop, under otherwise corresponding cons. Planting as early as the local climate admits es the benefit of the winter moisture.

o close planting interferes with a liberal or rapid development of the leaves, and too large open spaces between the

individual plants tends to favor a coarser structu three feet and four inches apart with plants two from each other in the row (Westfield), and row and eight inches apart with plants two feet from in the row (Hatfield) gave better returns than feet apart with plants eighteen inches from each row (Agawam).

2. A timely, shallow use of the cultivator or removal of weeds favors a uniform progress of g careless use of cultivator or hoe invariably chec less the growth of the plants, and modifies more structure and general character.

3. The different fertilizer mixtures used in ments have affected in a less marked degree the w crop raised by their aid than the quality. New lan by previous cropping to a state approaching gene tion of available plant food, if otherwise well fitted tobacco, have given excellent results when supp suitable mixture of fertilizing ingredients in qua ilar to those applied during our experiments (Such lands are at times preferable to old tobacco charged with remnants of all kinds of saline i usually associated with the common run of com tilizers.

4. Cotton-seed meal, linseed meal and castor p proved equally good sources of nitrogen for the raising of tobacco when used in connection with soda or potash, sufficient to furnish one-fourth of t called for by the crop.

5. Nitrate of soda as a part of the nitrogen the fertilizer (25 per cent.), when used in prese phosphate, dissolved bone-black, etc., has been a with better results regarding quality of crop tha potash under otherwise similar conditions.

6. Cotton-seed hull ashes and high-grade s potash have proved in our observation most valua of potash for tobacco, the former in the majori leading. Nitrate of potash has produced excel when used in connection with an alkaline phospha phatic slag meal or with carbonate of potash-magn

results with potash-magnesia sulphate as the main potash sources of a tobacco fertilizer are not encouraging.

7. The difference noticed in the color of ash, etc., in case of the crop being raised upon different plots, is in several instances so slight that an attempt to classify the various fertilizers used with reference to their superior fitness on the basis of color and compactness of ash cannot be otherwise than arbitrary. With this qualification in mind, the following classification is offered for the consideration of parties engaged in the cultivation of tobacco in our section of the country: —

First Class.

Plot 4. — Nitrate of soda, cotton-seed hull ashes and castor pomace.

Plot 3. — Nitrate of soda, cotton-seed hull ashes and cotton-seed meal.

Plot 9. — Nitrate of potash, cotton-seed hull ashes and cotton-seed meal.

Plot 10. — Nitrate of potash, carbonate of potash-magnesia and phosphatic slag.

Second Class.

Plot 6. — Nitrate of soda, high-grade sulphate of potash, cotton-seed meal and dissolved bone-black.

Plot 8. — Nitrate of soda, high-grade sulphate of potash, linseed meal and dissolved bone-black.

Plot 7. — Nitrate of soda, high-grade sulphate of potash, castor pomace and dissolved bone-black.

Third Class.

Plot 1. — Nitrate of potash, potash-magnesia sulphate, cotton-seed meal and dissolved bone-black.

Plot 2. — Nitrate of potash, potash-magnesia sulphate, castor pomace and dissolved bone-black.

The observations with barn-yard manure have not been considered in the above classification; they are very encouraging, but not sufficient in number to permit detailed discussion in this connection; besides, the amount of barn-yard manure used in our experiment, ten tons per acre, contained nearly two hundred pounds of potassium oxide and

from thirty to forty pounds of available phosphor
than our formula of commercial fertilizing ingredi
for.

An early application of barn-yard manure, pro
plemented with a suitable potash compound an
phosphoric acid, has produced excellent result
localities.

INDEX.

IC DOCUMENT . . . . No. 31.

THIRTY-FIFTH ANNUAL REPORT

OF THE

MASSACHUSETTS

-RICULTURAL COLLEGE.

JANUARY, 1898.

BOSTON:
-HT & POTTER PRINTING CO., STATE PRINTERS,
18 POST OFFICE SQUARE.
1898.

Commonwealth of Massachusetts.

MASSACHUSETTS AGRICULTURAL COLLEGE,
AMHERST, Jan. 1, 1898.

Excellency ROGER WOLCOTT.

: — I have the honor to transmit herewith, to Your ency and the Honorable Council, the thirty-fifth an- eport of the trustees of the Massachusetts Agricultural e.

I am, very respectfully,
Your obedient servant,

HENRY H. GOODELL,
President.

CONTENTS.

CALENDAR FOR 1898-99.

1898.

anuary 5, Wednesday, winter term begins, at 8 A.M.
Iarch 24, Thursday, winter term closes, at 10.15 A.M.
.pril 6, Wednesday, spring term begins, at 8 A.M.
une 18, Saturday, Grinnell prize examination of the senior class in agriculture.

une 19, Sunday, { Baccalaureate sermon. Address before the College Young Men's Christian Association.

une 20, Monday, { Burnham prize speaking. Meeting of the alumni. Flint prize oratorical contest.

une 21, Tuesday, { Class-day exercises. Military exercises. Reception by the president and trustees.

une 22, Wednesday, Commencement exercises.
une 23-24, Thursday and Friday, examinations for admission, at 9 A.M., Botanic Museum, Amherst; at Jacob Sleeper Hall, Boston University, 12 Somerset Street, Boston; and at Sedgwick Institute, Great Barrington. Two full days are required for examination, and candidates must come prepared to stay that length of time.
September 6-7, Tuesday and Wednesday, examinations for admission, at 9 A.M., Botanic Museum.
September 8, Thursday, fall term begins, at 8 A.M.
December 22, Thursday, fall term closes, at 10.15 A.M.

1899.

January 4, Wednesday, winter term begins, at 8 A.M.
March 23, Thursday, winter term closes, at 10.15 A.M.

ANNUAL REPORT OF THE TRUSTEES

OF THE

SACHUSETTS AGRICULTURAL COLLEGE.

cellency the Governor and the Honorable Council.

ing the thirty years of its existence, the college, in on with all the other land-grant colleges, has passed gh many vicissitudes. Heralded at first as the bright ng star, it soon lost popular favor, because it did not e make itself felt in the agriculture of the State and orm the fields of dock and thistles into broad acres ving grain. A season of depression ensued, followed by one of buoyancy and hope, in which it made great s. This in turn was succeeded by the financial es of the last few years, which it was the first to feel om which it has been the last to recover. Reviewing st, we cannot but feel that the stage of experiment is and we enter upon this the first year of its fourth e with quickened hope that from a broader, surer ation the college will continue to rise and fulfil its n of providing that "liberal and practical education hall fit the industrial classes for the several pursuits rofessions in life." The requirements for entrance been increased, the average rank has been raised, the s strengthened and broadened and the faculty in- d to meet the increased demands.

carry out the purpose for which the college was d, three separate courses have been established. to meet the requirements of those whose circum- s forbid a longer stay, a series of ten short winter s, eleven weeks in length, but covering such practi-

cal instruction in agriculture and the allied scie
be most helpful to the farmer. For this exam
not required, and neither degrees nor diplom
ferred. Elective courses in botany, entomolog
ure, fruit culture, market gardening and dai
been thrown open to women, but it is unfo
lack of dormitory room practically excludes
taking advantage of this instruction. Second,
course, leading to the degree of Bachelor of Sc
the first three years a certain definite curriculum
of all, while the studies of the fourth year, wit
tion of English and military science, are entir
Examinations must be passed for this cour
post-graduate courses, leading to the degrees o
Science and Doctor of Philosophy. Candidat
degrees are required to choose one major and
studies from certain prescribed subjects.

The academic course of four years is divid
nine departments, with the following allotment
the different studies: —

English language and literature,	. . . .
Other languages,	. . . .
Mathematics and drawing,	. . . . .
Chemistry and physics,	. . . . . .
Botany,	. . . .
Entomology, zoölogy and physiology,	. .
Economic law and history,	. . . . .
Military science and practice,	. . . . . .
Agricultural in general,	. . . . . .
Horticulture,	. . . .
Veterinary,	. . . .
Geology and astronomy,	. . . . . .
Total,	. . . .

Briefly, the course in each department may
lined: —

AGRICULTURE.

(*a*) The origin and formation of soils, th
properties and how to improve them; (*b*) till
ing, drainage and irrigation; (*c*) use of fer

manures; (*d*) farm implements and plans of farm buildings; (*e*) animal husbandry, breeds, stock breeding and feeding. As aids to practical instruction, there are models of the domestic animals; a farm of four hundred acres; a barn with one hundred head of stock, types of the leading breeds, and a complete dairy outfit, where the operations of pasteurizing milk and cream, butter making, milk testing and separation of cream are carried on.

Botany.

(*a*) Structural and systematic botany; (*b*) economic botany; (*c*) study of the normal functions and diseases of plants; (*d*) plant physiology and its relation to agriculture. For practical work there is a laboratory abundantly supplied with microscopes, microtomes, histological reagents and numerous appliances for illustration and investigation of the phenomena of plant life.

Chemistry.

The chemical department teaches the composition, the value and the uses of all products of nature and of art. This study is an essential part of the training of the farmer, the manufacturer, the business man, the physician and the advanced student of any subject, for it deals with the ultimate character of all kinds of matter.

The special fields of study are mineral and organic, the latter including vegetable and animal matter. Each of these is studied by analysis and synthesis both qualitative and quantitative. There are three laboratories to suit the varying wants of the students.

Chemical Instruction.

Domains.				*Methods.*
Mineral.		Each studied by	Analysis,	qualitative.
				quantitative.
Organic,	vegetable.		Synthesis,	qualitative.
	animal.			quantitative.

English.

The aim of this department is to promote:
to give oral and written expression of thought
effective English; (*b*) ability to present in lo
oral and written arguments on questions as
debate; (*c*) acquaintance with the masterpieces
literature. This is secured by constant practice
and speaking, and by the study of American lite
rhetoric in freshman and sophomore years and En
ature and logic in the junior and senior. Instructi
partly by text-book and partly by lecture. The
rhetoric consists of a study of the choice of words,
of phraseology, special objects in style, the se
paragraph, the whole composition as regards pla
ment and parts. This is followed by a series of
invention, taking up the different elements and
principles of literature. The work in American
is partly by text-book and partly by lecture.
in the last two years is carried on in the same
practical way, debate taking the place of declama

Horticulture.

Instruction is given in: (*a*) fruit culture; (
gardening; (*c*) floriculture; (*d*) forestry. Fo
work there are extensive, well-stocked orchards
and greenhouses, where the production of fru
garden and greenhouse crops is constantly carrie

Mathematics and Engineering.

(*a*) Pure mathematics; (*b*) physics; (*c*) dra
engineering. The department is well supplied
necessary instruments for surveying and engine
practical work in the field is required. A lab
physics has recently been opened, where the s
solve for himself problems in mechanics, electr
and sound. The senior engineering option is d
give to the student the necessary engineering

enable him to take up and apply, on the lines of landscape engineering and the development of property, his knowledge of landscape gardening, agriculture, forestry, botany and horticulture. It embraces a course of lectures, recitations and field work on the following subjects: topography, railroad curves, earth work, construction and maintenance of roads, water works and sewerage systems, etc.

Military.

This was established by act of Congress, and all students, unless physically disabled, are required to attend its exercises. Its object is threefold: first, the dissemination of military knowledge throughout the country; second, physical exercise and muscular training; and third, to inculcate respect and obedience to those in authority. There are three hours' drill per week for the whole college, one hour recitation for the senior class and a weekly inspection of the rooms in the dormitory.

Political Economy.

To make a good citizen and a successful man of business is the aim of this department. To realize this aim the course of instruction covers: (*a*) principles of political economy; (*b*) industrial history of England and America; (*c*) discussion of economic problems; (*d*) study of the science of government.

Veterinary.

To give a general idea of the principles of veterinary science in such simple and comprehensive manner as to enable any person to give animals under his supervision the treatment that will tend to prevent the occurrence of disease among them, is the aim of the course of study in this department. (*a*) The hygiene of the stable; (*b*) the anatomy and physiology of the circulatory, respiratory and digestive systems; (*c*) a study of the common diseased processes and the causes, symptoms and effects of disease; (*d*) the nature, action and uses of different drugs. Skeletons

of the domestic animals, specimens of diseased
tissue, and an Auzoux model of the horse form a p
equipment. This study is elective.

Zoölogy.

The work in this department commences with
of human anatomy and physiology. It is follo
course in zoölogy, taught by lectures and work in
ratory. In the laboratory each student is require
sect and study a series of typical animals, making
of the different organs. After this preparation
of insects is taken up, — their classification and h
the various methods of destroying those that are
In the senior year an elective course of more
lectures is given, embracing such subjects as the
embryology, transformations, duration of life,
diseases of insects, and the fertilization of plants
Each student is required to do original work and
thesis before graduation. The whole is suppleme
carefully arranged museum, containing, as far as
all the native animals of the Commonwealth, an
extensive entomological collections of the pro
charge.

Faculty.

The faculty number eighteen active resident
one professor emeritus and one non-resident lectu
chair of mathematics and civil engineering made
the resignation of Prof. Leonard Metcalf has been
the election of John E. Ostrander, C.E., late pr
civil engineering and mechanic arts in the College
culture of the University of Idaho. Prof. W
Brooks, after a year's absence spent in study ab
resumed his duties at the college. The mecha
free-hand drawing heretofore conducted by the mil
cer will this year, as last, be taught by Mr. W
Armstrong, a member of the junior class.

For a makeshift, until such time as a suitable
can be erected, the recitation room occupied by
dent has been altered into a physical laboratory fo

of the junior class. Water and gas have been introduced, a small dynamo run by water motor has been installed, benches accommodating twenty to thirty workers fitted up, and the light regulated by shutters sliding up and down, operated by hydrostatic stop-cocks on the table.

It has been the policy to add each year, as opportunity presented or as there seemed demand, new studies to the optional courses. This year there is offered a course in general history, commencing with the Christian era, a course in geology and a course in astronomy.

The entering class was one-fourth larger this year than last, and there was a number of additions to higher classes. But the same deficiency in preparation still prevails. The applicants for admission represent nearly every county in the State. They come from the hills of Berkshire and the sands of the Cape, from the valley of the Connecticut and the shores of Massachusetts Bay. They are not farmers' sons alone, but come from the homes of mechanics, of nurserymen, of engineers, of those, in fact, who represent the "industrial classes," "to promote the liberal and practical education" of whom "in the several pursuits and professions in life" the Agricultural College was established. These applicants for admission are examined in the following subjects: arithmetic, algebra through quadratic equations, geometry (two books), English grammar and composition, descriptive geography, physical geography, United States history, civil government and physiology. To be successful in this examination an applicant must obtain a mark of 65 per cent. Of the last 247 applicants for admission, 54 failed in arithmetic at the first examination, 93 in algebra, 70 in geometry, 49 in English grammar, 41 in descriptive geography, 37 in physical geography, 39 in history, 38 in civil government and 41 in physiology. The largest number of failures have been in algebra, — 33⅙ per cent.; the smallest number in physical geography, — 15 per cent.; while the average of failures in the nine subjects specified above is 26¾ per cent.

We have, then, an average of more than one-fourth of those who have presented themselves for admission to the

college failing in the entrance examinations. urged that too much importance should not be failures in these tests; that examiners are often in the questions asked; that "Tom is always such times," and that "Henry can never do jus self on an examination." These and other sim may be allowed, yet the deplorable fact rema many are "plucked" when the test comes.

As has been intimated, these candidates are sentatives of the pupils in our public schools. graduates of the high school, many more have two years in the same. The fact of their failu necessarily, be charged to the public school, for schools furnish many students who not only p trance examination, but, after a four-years cour with honor and success. The fault, or the limit is with the student himself or with those who sh him. *The time devoted to preparation is to* young man suddenly awakes to the idea that enter the Agricultural College. He fancies t shaky foundation of a possible year in the high or five weeks can build a preparation for co *time is too short.* Another, possessed of a s thinks that a few evenings of study, after the da done, will enable him to "brush up" his mathem *body is too tired.* He falls asleep over those di ciples of geometry, and there is no time for th and repeated solution of problems by which alo of algebraic processes becomes familiar. The successful work in any college require time and study in the work of preparation.

That each year we are drawing into closer with the agriculture of the State is apparent. are coming more and more to depend upon the what is true now is just as surely going to inc future. In nothing does this more strikingly in the matter of correspondence. During the months 5,528 letters have been answered in the department alone. What does this mean? It

t 5,528 points we have touched the interests of the agri-ultural life of this State. It means that 940 dairymen have ranted to know about butter fats, or the best-balanced ration, r the hundred other matters of vital interest. It means hat 750 farmers have had questions to ask concerning fer-ilizers and fertilizer materials. It means that 316 intelli-ent men engaged in the practice of agriculture have wanted nformation respecting rotation of crops, millets and soya eans, or the effects of potash on the growth of corn. It neans that 304 fruit growers have come and asked what vere the best varieties of fruits, how to cultivate them and ow to prevent disease. It means that 113 growers of owers and vegetables under glass have been attacked by usts, smuts or nematodes, and have lifted up the Macedo-ian cry, "Come over and help us." It means that 1,232 ufferers attacked by all kinds of winged, crawling, creep-ng foes have come to us for relief. It means that 103 ood wives have seen the ruin of their household idols ffected by the buffalo bug, and have cried out in their nguish, "What shall we do to be saved from these pests?" This is the work of only one department. In addition, there ave been written from the office of administration during he same period over 7,000 letters on matters touching col-ege interests.

Expenditure of State Appropriations.

The several amounts appropriated by the Legislature (chapter 15, Acts and Resolves of 1897) have nearly all een expended, and for the purposes indicated. The entire vater system of the college has been replaced, furnishing mple protection from fire as well as an adequate amount for lomestic supply. An emergency reservoir, with a capacity of 150,000 gallons, has been constructed on the highest point of the college grounds; 7,352 feet of six-inch and 2,172 feet of four-inch cast-iron pipe have been laid, with the necessary gates, hydrants and valves. The fire appa-ratus has been thoroughly overhauled, and 500 feet of Eureka, U. S., rubber-lined hose, two and five-eighths inches in diameter, with hose play pipes, hose connections and

straps have been purchased. The whole work
the appropriation, though it was found necess
down and reconstruct at a large additional expe
vert through which the pipe was laid at the sout
pond. It is safe to say that, but for the untirin
Prof. Leonard Metcalf, the supervising enginee
his time and his services without compensation,
could not have successfully carried through thi
ing. It seems fitting, therefore, in this public
place on record our grateful recognition of the
done for the college. As a corollary to the ch
water system, we were enabled to place, at slig
water-closets and facilities for bathing in the n
tory, — a much-needed improvement, whether
the stand-point of comfort or sanitation.

The greenhouse for the investigation of pl
has been entirely remodelled, but the work i
completed. The laboratory for teaching botan
enlarged to meet the requirements of changes i
of study and consequent increase of students.
well lighted, well ventilated and commodious.
on the two greenhouses have been practicall
and they are both in use.

Accommodations for the Sick.

It may be proper to state that, through the ge
the donor of Pratt Cottage, Mr. George D. Pr
Island City, those of our students requiring
result of accident or sickness may enjoy the ad
the hospital, on the payment of a fixed sum
subject to the same rules and regulations as
Amherst College. It is a great satisfaction to
cases of serious illness our students can be re
the college buildings and receive proper care.

The Military Department.

This department, required by act of Congr
cepted by the Commonwealth of Massachuset
ceived no particular encouragement, although it

rades and drills form one of the most pleasing features f Commencement week. The War Department, as an centive to good work, publishes each year in the "Army egister" the names of the three graduates in each college commended by the president and commandant as having ood highest in the military department of the college.

One State, at least, has supplemented this by an act titling each graduate of the Agricultural and Mechanical ollege of that State, who may be declared proficient by e United States army officer in charge, to a commission brevet second lieutenant in the State militia. We would rnestly recommend petitioning the General Court for the ssage of an act entitling the three graduates recommended ch year for honorable mention in the "Army Register" a commission as brevet second lieutenant in the Massa-usetts State militia. It would be an incentive to the idents themselves, and would offer an inducement to the uth of the State to enter an institution where excellent cilities are offered for military training.

Needs of the College.

Commissioner Harris never made a truer remark than ien he said, "The laboratory is the pivot on which the gricultural College is wheeling around to lead in this, e greatest of American education." But what he says of e college as a whole is equally applicable to every depart-ent. Instruction, without laboratory work to impress upon e mind the principles learned in the recitation room, is of tle value. Precept and practice must go hand in hand, to ke the exact scholar. Most of the departments are fairly ll equipped for laboratory work. The veterinary is almost e sole exception, and in the present crowded state of the ildings it is impossible to find any adequate quarters. A gle room, nine by fourteen feet, with one window, is all e space that can be allotted for practical work with the idents in dissection or in the use of the microscope. For k of other accommodations, the professor in charge is mpelled to keep in the cellar of his own house animals which he desires to experiment, or diseased subjects and

carcasses that may be sent in for examination
of the domestic animals and their products in
is something enormous, footing up to nearly
half billions of dollars, distributed as follows:

UNITED STATES STATISTICS.

Dairy Products for 1895 (Estimated).

PRODUCT.	Total Product.	Rate of Value.
Butter (pounds), . .	1,375,000,000	$0 20
Cheese (pounds), . .	280,000,000	08
Milk (gallons), . .	1,750,000,000	09
Total, . . .	–	–

Number of fowls, ...	
Number of dozens of eggs produced, ...	1
Value of both, ...	$
Total value of farm animals, ...	$1.
Total value of dairy products, ...	
Total value of poultry and products, . . .	
Total, ...	$2,

In Massachusetts the latest figures give: —

MASSACHUSETTS STATISTICS.

1896.	Number.	Price.
Horses, ...	198,568	$64 67
Cows, ...	174,167	30 78
Cattle other than cows, .	38,437	16 00
Sheep, ...	34,091	3 38
Swine, ...	40,570	8 44
Poultry, ...	553,970	–
Total, . . .	–	–

Value of Dairy Products.

1896.	Quantity.	Price.	Value.
allons), . .	82,571,924	$0 09	$7,431,473 00
(pounds), . .	10,410,300	20	2,082,060 00
(pounds), . .	385,533	08	30,842 00
al, . . .	–	–	$9,544,375 00

s are from estimates of 1895, made to apply to products in United They should be higher for Massachusetts.

lue of farm animals, ...	$19,521,586 20
lue of dairy products, ...	9,544,375 00
lue of poultry products,*	553,970 00
Total, ...	$29,619,931 20

s estimated that there is an annual loss of 6 per cent. s valuation, resulting from disease, most of which is itable. There is not, if I am informed correctly, a place in this State where the prime object is the of the diseases of the domestic animals. Other States lready recognized the importance of this subject, and led means of instruction and study, for the two go in hand. Pennsylvania has appropriated $30,000 veterinary department of its university. Iowa has hed the necessary buildings for its college. New has granted $150,000 for buildings and $25,000 annu-or running expenses. Ohio has appropriated large but the exact figures have not been ascertained. In dinary business of life, where great capital is invested, rvices of experts are sought. In this great industry, ich nearly thirty millions of capital are engaged, pro- has not yet been made for the intelligent study of l diseases, though nearly a million dollars' loss occurs lly through lack of knowledge. The natural place e dissemination of such knowledge and for the study

* 2,769,850 dozen eggs, at 20 cents.

of the various plagues affecting our domestic animals the veterinary department of the college, and for this t things are absolutely essential, — a laboratory and hospit stable connected therewith, and a small annual appropr tion for maintenance. The laboratory, with its recitat room, workshop and museum, is both educational a experimental. The stable, while it subserves both p poses, is more especially for investigation. It require larger outlay than at first thought may seem necessary. must be built in a different manner from ordinary stabl to meet the exigencies of the case. Room should be p vided for six stalls, each absolutely isolated from the othe cut off by a brick partition, the walls covered with adam cement and the floors of artificial stone, so as to ins absolute disinfection at the close of each investigati In this particular the bovine race is in no ways differ from the human. Modern science would never think introducing a patient suffering from typhoid fever int small-pox or scarlet-fever ward. In like manner, ge infected timber or earth would never do in stalls in wh one week might be an aggravated case of cow-pox and next one of tuberculosis. To provide for these buildi and their equipment we ask for $25,000 and an ann maintenance fund of $1,000.

The chemical department requires for equipment a material the sum of $1,000 in order to place it in posit to offer the educational facilities demanded. Charts, mode material, apparatus and chemicals are needed. With changes made in the college curriculum, new wants have be supplied. The senior electives, the post-graduate cours the short winter courses call for instruction in almost ev branch of theoretical and applied chemistry, and dem strations in a wide range of subjects are made necessa These include agricultural chemistry, physiological and m ical chemistry, assaying, mineral analysis, metallurgy, analysis, sugar manufacturing, color chemistry and ma other industrial processes. To answer these requireme there should be an abundance of material on hand demonstration. In no other department is there so gr

d at the same time so unavoidable a consumption of aterial and using up of perishable equipment, most of iich has to be imported. In almost every other college find a certain definite sum, ranging from $700 to $1,000, nually appropriated to supply this waste. Lack of means s prevented such annual repair of loss, and at irregular ervals we are compelled to apply for aid.

Among the many unsolved problems confronting the ryman is the effect of feed stuffs on the consistency and vor of butter. Experiments in the past have been for the st part confined to the production of quantity. Dairyn are now calling for investigations of quality. Such rk requires the erection and equipment of a small dairy lding for purpose of experiment alone. A plant of this cription would call for an outlay of $2,000 for the folving special items: —

(*a*) A building 22 by 44 feet, with ice-house attached, by 20 feet, including floor of artificial stone for creamery.

(*b*) Creamery fittings (boiler, engine, apparatus).

(*c*) Drainage.

(*d*) Heating building and connecting tanks.

In brief, then, the following amounts are asked for: —

Veterinary laboratory and equipment, . . .	$25,000
Chemical equipment, ...	1,000
Dairy plant, ...	2,000
	$28,000

l an annual maintenance fund of $1,000, veterinary detment.

In accordance with the act of Congress establishing these leges, and requiring in their annual report the publican of matter of information to the people, an illustrated per is appended by Prof. Charles H. Fernald on the me-moths.

Respectfully submitted, by order of the trustees,

HENRY H. GOODELL,

President.

MHERST, Jan. 1, 1898.

THE CORPORATION.

	Term expi
WILLIAM H. BOWKER of BOSTON,	18
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WILLIAM R. SESSIONS, *Secretary of the Board of Agricultur*

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SLEY B. BARTON, . . of Dalton.

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he president of the college is ex officio a member of each of these com-
es.

The Faculty.

HENRY H. GOODELL, LL.D., *President*,
Professor of Modern Languages.

LEVI STOCKBRIDGE,
Professor of Agriculture, Honorary.

CHARLES A. GOESSMANN, PH.D., LL.D.,
Professor of Chemistry.

SAMUEL T. MAYNARD, B.SC.,
Professor of Horticulture.

CHARLES WELLINGTON, PH.D.,
Associate Professor of Chemistry.

CHARLES H. FERNALD, PH.D.,
Professor of Zoölogy.

REV. CHARLES S. WALKER, PH.D.,
Professor of Mental and Political Science.

WILLIAM P. BROOKS, PH.D.,
Professor of Agriculture.

GEORGE F. MILLS, M.A.,
Professor of English and Latin.

JAMES B. PAIGE, D.V.S.,
Professor of Veterinary Science.

GEORGE E. STONE, PH.D.,
Professor of Botany.

JOHN E. OSTRANDER, M.A., C.E.,
Professor of Mathematics and Civil Engineering.

HERMAN BABSON, M.A.,
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FRED S. COOLEY, B.Sc.,
Assistant Professor of Agriculture.

RICHARD S. LULL, M.S.,
Assistant Professor of Zoölogy.

RALPH E. SMITH, B.Sc.,
Instructor in German and Botany.

PHILIP B. HASBROUCK, B.S.,
Assistant Professor of Mathematics.

ILLIAM M. WRIGHT, 1st Lieut., 2d Infantry, U.S.A.,
Professor of Military Science and Tactics.

ROBERT W. LYMAN, LL.D.,
Lecturer on Farm Law.

HENRY H. GOODELL, LL.D.,
Librarian.

Graduates of 1897.*

Master of Science.

gess, Albert Franklin, . . .	Rockland.
ney, Asa Stephen, . . .	Worcester.

Bachelor of Science.

en, Harry Francis (Boston Univ.), .	Northborough.
en, John William (Boston Univ.), .	Northborough.
nstrong, Herbert Julius (Boston Jniv.), ...	Sunderland.
ry, John Marshall (Boston Univ.),	Boston.
tlett, James Lowell (Boston Univ.),	Salisbury.
ney, Liberty Lyon (Boston Univ.),	Southbridge.
rk, Lafayette Franklin (Boston Jniv.), ...	West Brattleboro, Vt.

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* The annual report, being made in January, necessarily includes parts of two emic years, and the catalogue bears the names of such students as have been ected with the college during any portion of the year 1897.

Drew, George Albert (Boston Univ.),	Westford.
Emrich, John Albert, . . .	Amherst.
Goessmann, Charles Ignatius (Boston Univ.), ...	Amherst.
Leavens, George Davison (Boston Univ.), ...	Brooklyn Heights, N.
Norton, Charles Ayer (Boston Univ.),	Lynn.
Palmer, Clayton Franklin (Boston Univ.), ...	Stockbridge.
Peters, Charles Adams (Boston Univ.),	Worcester.
Smith, Jr., Philip Henry (Boston Univ.), ...	South Hadley Falls.
Howe, Edward Gardnier ('72), . .	Urbana, Ill.
Stone, George Edward ('86), . .	Amherst.
Total, ...	. . . .

Senior Class.

Adjemian, Avedis Garrabet, . .	Kharpoot, Turkey.
Baxter, Charles Newcomb, . .	Quincy.
Clark, Clifford Gay, ...	Sunderland.
Eaton, Julian Stiles, . . .	Nyack, N. Y.
Fisher, Willis Sikes, . . .	Ludlow.
Montgomery, Jr., Alexander, . .	Natick.
Nickerson, John Peter, . . .	West Harwich.
Warden, Randall Duncan, . .	Roxbury.
Wiley, Samuel William, . . .	Amherst.
Wright, George Henry, . . .	Deerfield.
Total, ...	. . . .

Junior Class.

Armstrong, William Henry, . .	Cambridge.
Beaman, Dan Ashley, . . .	Leverett.
Boutelle, Albert Arthur, . . .	Leominster.
Canto, Ysidro Herrera, . . .	Cansahcat, Yucatan.
Chapin, William Edward, . . .	Chicopee.
Chapman, John Chauncey, . .	Amherst.

rtney, Howard Scholes, . .	Attleborough.
na, Herbert Warner, . . .	South Amherst.
cher, John Remson, . . .	Nyack, N. Y.
ds, Warren Elmer, . . .	Townsend.
oker, William Anson, . . .	Amherst.
bbard, George Caleb, . . .	Sunderland.
ynard, Howard Eddy, . . .	Amherst.
gree, Melvin Herbert, . . .	Denmark, Me.
rpe, Edward Hewett, . . .	Northfield.
th, Bernard Howard, . . .	Middlefield.
th, Carl William, ...	Melrose.
th, Samuel Eldredge, . . .	Middlefield.
cy, Clifford Eli, ...	Gloucester.
ner, Frederick Harvey, . .	Housatonic.
lker, Charles Morehouse, . .	Amherst.
ght, Edwin Monroe, . . .	Manteno, Ill.
Total, ...	22

Sophomore Class.

kins, Edwin Kellogg, . . .	North Amherst.
ker, Howard, ...	Dudley.
wn, Frank Howard, . . .	Newton Centre.
npbell, Morton Alfred, . . .	Townsend.
ne, Henry Lewis, ...	Ellis.
well, Jr., Charles Augustus, . .	Everett.
well, Warner Rogers, . . .	Everett.
ch, Percy Fletcher, . . .	Worcester.
st, Arthur Forrester, . . .	South Monmouth, Me.
e, Alfred Dewing, . . .	Worcester.
ligan, James Edward, . . .	Roslindale.
rmon, Arthur Atwell, . . .	Chelmsford.
l, Edward Taylor, . . .	Greenfield Hill, Conn.
nting, Nathan Justus, . . .	Shutesbury.
logg, James William, . . .	Amherst.
nders, Morris Bernard, . . .	Bondsville.
vis, James, ...	Fairhaven.
rch, Allen Lucas, ...	Ashfield.
rrill, Frederic Augustus, . .	Boston.
nahan, Arthur Coleman, . .	South Framingham.
rrill, Austin Winfield, . . .	Tewksbury.

Munson, Mark Hayes, . . .	Huntington.
Otis, Wilbur Corthell, . . .	Beachmont.
Ovalle Barros, Julio Moises, . .	Santiago, Chili.
Parmenter, George Freeman, . .	Dover.
Risley, Clayton Erastus, . . .	Plainfield, N. J.
Rogers, William Berry, . . .	Cambridge.
Saunders, Edward Boyle, . . .	Southwick.
Stanley, Francis Guy, . . .	Springfield.
Walker, Henry Earl, ...	Vineyard Haven.
West, Albert Merril, ...	Brookville.
Total, ...	

Freshman Class.

Ahearn, Michael Francis, . . .	Framingham.
Baker, John Brown, ...	Amherst.
Barry, John Cornelius, . . .	Amherst.
Boutelle, Clarence Alfred, . . .	Leominster.
Bridgeforth, George Ruffin, . .	Westmoreland, Ala
Brooks, Percival Cushing, . . .	Brockton.
Casey, Thomas, ...	Amherst.
Chickering, James Henry, . . .	Dover.
Clarke, George Crowell, . . .	Malden.
Cooke, Theodore Frederic, . .	Austerlitz, N. Y.
Curtis, Ernest Waldo, . . .	Canton.
Dana, George Henry, . . .	South Amherst.
Dawson, William Alucius, . . .	Worcester.
Dickerman, William Carlton, . .	Taunton.
Dorman, Allison Rice, . . .	Springfield.
Gamwell, Edward Stephen, . .	Pittsfield.
Gordon, Clarence Everett, . . .	Clinton.
Graves, Jr., Thaddeus, . . .	Hatfield.
Gurney, Victor Henry, . . .	Forge Village.
Hemenway, Francis Ellis, . . .	Williamsville.
Henry, James Buel, ...	Scitico, Conn.
Howard, John Herbert, . . .	Littleton Common.
Jones, Clark Winthrop, . . .	Huntington.
Jones, Cyrus Walter, . . .	Amherst.
Judd, Warren Harold, . . .	South Hadley Falls
Leslie, Charles Thomas, . . .	Pittsfield.
Macomber, Ernest Leslie, . . .	Taunton.

[oulton, Harry Jackson, ...	Milford.
aul, Herbert Amasa, . . .	Lynn.
ice, Charles Leslie, ...	Pittsfield.
oot, Luther Augustus, . . .	Deerfield.
nith, Ralph Ingram, . . .	Leverett.
ashjian, Dickran Bedross, . .	Kharpoot, Turkey.
odd, John Harris, ...	Rowley.
ilson, Alexander Cavassa, . .	Boston.
Total, ...	35

Graduates' Two-Years Course.

bley, Henry Simeon, . . .	East Longmeadow.
rrington, John Cecil, . . .	Charlemont.
lburn, Charles Day, . . .	Westford.
e, Willie Arius, ...	Sheffield.
mphrey, Charles Leonard, . .	Amherst.
erriman, Francis Evander, . .	Boston.
Total, ...	6

Short Winter Courses.

ams, Charles Moody, . . .	Wayland.
armbury, Thomas Herbert, . .	Amherst.
ashi, Louie Yeizo, . . .	Imadzumura, Japan.
escher, John Fred, . . .	Cherry Valley.
ke, Charles Daniel, . . .	Hampden.
ler, Herman Kelso, . . .	Lowell.
ham, Charles Sumner, . . .	Westborough.
t, Jonathan Edward, . . .	Andover.
pkins, Lemuel Truesdell, . .	Conway.
wes, Albert Lorenzo, . . .	Ashfield.
ch, Oliver Herbert, . . .	Florence.
ore, George Calvin, . . .	Leverett.
dleton, Charles Bemis, . . .	Willimansett.
rman, Wilbur Gifford, . . .	Haverhill.
ith, Charles Atherton, . . .	Buckland.
well, Herbert Willard, . . .	Leverett.
Total, ...	16

Graduate Course.

For Degree of M.S.

Armstrong (B.Sc., M. A. C., '97), Herbert Julius,	Sunderland.
Caudell (B.S., Oklahoma, '96), Andrew Nelson,	Kansas City, Mo.
Goessmann (B.Sc., M. A. C., '97), Charles Ignatius,	Amherst.
Hemenway (B.Sc., M. A. C., '95), Herbert Daniel,	Williamsville.
Kochi (B.S., Sapporo, '91), Chujiro,	Bingo, Japan.
Leavens (B.Sc., M. A. C., '97), George Davison,	Brooklyn Heights,
Palmer (B.Sc., M. A. C., '97), Clayton Franklin,	Stockbridge.
Peters (B.Sc., M. A. C., '97), Charles Adams,	Worcester.
Stevens (B.A., Harvard Univ., '95), Waldo Warland,	Groton.
Total,	

Resident Graduates at the College and Experiment Sta

Cooley, B.Sc., Robert Allen,	South Deerfield.
Drew, B.Sc., George Albert,	Westford.
Hammar, B.Sc., James Fabens,	Swampscott.
Haskins, B.Sc., Henri Darwin,	North Amherst.
Holland, B.Sc., Edward Bertram,	Amherst.
Holt, B.Sc., Jonathan Edward,	Andover.
Jones, B.Sc., Benjamin Kent,	Middlefield.
Kinney, B.Sc., Asa Stephen,	Worcester.
Putnam, B.Sc., Joseph Harry,	West Sutton.
Roper, B.Sc., Harry Howard,	East Hubbardston.
Smith, B.Sc., Frederic Jason,	North Hadley.
Smith, Jr., B.Sc., Philip Henry,	South Hadley Falls.
Smith, B.Sc., Robert Hyde,	Amherst.
Thomson, B.Sc., Henry Martin,	Monterey.
White, B.Sc., Edward Albert,	Ashby.
Total,	

Special Students.

oss (Amh. Coll.), Edward Winslow,	Manchester, N. H.
oward (Amh. Coll.), Arthur Day, .	Glencoe, Ill.
endall (Amh. Coll.), Henry Plimpton,	Walpole.
Total, ... 3	

Summary.

aduate course: —		
For degree of M.S., ...	9	
ur-years course: —		
Graduates of 1897, ...	19	
Senior class, ...	10	
Junior class, ...	22	
Sophomore class, ...	31	
Freshman class, ...	35	
o-years course: —		
Graduates of 1897, ...	6	
nter course, ...	16	
sident graduates, ...	15	
ecial students, ...	3	
Total, ...		166
tered twice, ...		9
Total, ...		157

FOUR-YEARS COURSE OF STUDY.

Freshman Year.

	Agriculture.	Botany and Horticulture.	Chemistry.	Natural History.	Mathematics.	Latin and English.	French and Social Science.	Drawing and Military.
Fall, . .	- - -	Botany, structural, — 5.	- - -	- - -	Advanced algebra, — 5. Book-keeping, — 2.	English, — 3.	French, — 4.	Study of tactics, — 1.
Winter, .	History of agriculture, soils and soil formation, — 4.	- - -	- - -	- - -	Advanced algebra and geometry (plane), — 4.	English, — 3.	French, — 4.	Mechanical drawing, — 6.
Summer, .	Soils: — characteristics, improvement of, drainage, etc., — 4.	Botany, analytical, — 4.	Lectures in elementary chemistry, — 3.	- - -	Geometry (solid), — 3.	English, — 3.	French, — 3.	- -

Sophomore Year.

	Agriculture.	Botany and Horticulture.	Chemistry.	Natural History.	Mathematics.	Latin and English.	French and Social Science.	Drawing and Military.
Fall, . .	Irrigation, disposition of sewage, manures and fertilizers, — 4.	Botany, economic, and laboratory work, — 4.	Lectures in elementary chemistry, — 4.	- - -	Trigonometry and surveying, — 5.	English, — 2.	- -	- -
Winter, .	- - -	Laboratory work, — 4.	Lectures and practice, — 4.	Anatomy and physiology, — 4.	Mechanics, — 2. Surveying, — 1.	English, — 3.	- -	- -
Summer, .	Relations of the atmosphere to plant-life, mowings, pastures, grasses, ensilage, — 5.	Horticulture, — 5.	Dry and humid qualitative analysis, — 6.	- - -	Surveying, — 4.	English, — 2.	- -	- -

	Agriculture.	Botany and Horticulture.	Chemistry, Geology and Astronomy.	Zoölogy.	Mathematics.	Latin and English.	French and Social Science.	Drawing and Military.
Fall, . .	Field crops, seed raising, production and improvement of varieties, machines and implements, — 4.	Market gardening, — 3.	Qualitative analysis, — 5.	Zoölogy, laboratory work, — 8.	Physics, — 2.	English literature, — 4.	- -	- -
Winter, .	Breeds and breeding of live stock, poultry farming, — 2.	- - -	Lectures and practice in organic chemistry, — 6.	Zoölogy, — 3.	Physics, — 3. Laboratory physics, — 2.	English literature, — 4.	- -	- -
Summer, .	- - -	Landscape gardening, — 5.	The same continued, — 5.	Entomology, — 6.	Physics, — 4. Laboratory physics, — 2.	English, — 2.	- -	- -

Senior Year (Elective).*

	Agriculture.	Botany and Horticulture.	Chemistry, Geology and Astronomy.	Zoölogy.	Mathematics.	Latin and English.	French and Social Science.	Drawing and Military.
Fall, . .	Dairy farming, — 5.	Botany, cryptogamic, — 8.	Chemical physics and quantitative analysis, — 8. Astronomy, — 5.	Entomology, — 8. Veterinary science, — 5.	Engineering, — 5. Analytical geometry, — 5.	English, — 2. Advanced English, — 5. Latin, — 5.	Political economy, — 5. German, — 5. History, — 5.	Military science, — 1.
Winter, .	Cattle feeding, — 5.	Botany, cryptogamic, — 8.	Advanced work with lectures, — 8. Astronomy, } 5. Geology, }	Entomology, — 8. Veterinary science, — 5.	Engineering, — 5. Differential calculus, — 5.	English, — 2. Advanced English, — 5. Latin, — 5.	Political economy, — 5. German, — 5. History, — 5.	Military science, — 1. Law lectures, — 1.
Summer, .	Experimental work in agriculture, — 5.	Botany, physiological, — 8.	The same continued, — 8. Geology, — 5.	Entomology, — 8. Veterinary science, — 5.	Engineering, — 5. Integral calculus, — 5.	English, — 2. Advanced English, — 5. Latin, — 5.	Constitutional history, — 5. German, — 5. History, — 5.	Military science, — 1.

* English and military science are required; of the other studies three at least must be chosen.

SHORT WINTER COURSES.

[All courses optional.]

Agriculture.

I. General Agriculture.

1.	Soils and operations upon them, drainage, irrigation, etc.,	10
2.	Farm implements and machinery,	5
3.	Manures and fertilizers,	10
4.	Crops of the farm, characteristics, management, etc.,	10
5.	Crop rotation,	2
6.	Farm book-keeping,	5
7.	Agricultural economics,	11
8.	Farm, dairy and poultry management,	11
	Total hours,	64

II. Animal Husbandry.

1.	Introduction,	
2.	Location and soil,	
3.	Building,	
4.	Breeds of cattle,*	
5.	Breeds of horses,	
6.	Grain and fodder crops,*	
7.	Foods and feeding,*	
8.	Extra,	
	Total hours,	

* With dairy course.

Dairying.

III. Lectures and Class-room Work.

1.	The soil and crops,	22
2.	The dairy breeds and cattle breeding,	22
3.	Stable construction and sanitation, care of cattle,	11
4.	Common diseases of stock, their prevention and treatment,	11
5.	Foods and feeding,	11
6.	Book-keeping for the dairy farm and butter factory,	22
7.	Pasteurization and preparation of milk on physicians' prescriptions,	11

III. Lectures, etc.—Concluded.

8.	Composition and physical peculiarities of milk; conditions which affect creaming, churning, methods of testing and preservation,	
9.	Milk testing,	
10.	Butter making,	
11.	Practice in aeration, pasteurization,	
	Total hours,	

Horticulture.

IV. Fruit Culture.

1.	Introduction,	1
2.	Propagation of fruit trees by seed, budding, grafting, forming the head, digging, planting, pruning, training, cultivation, etc.,	28
3.	Insects and fungous diseases,	3
	Total hours,	32

V. Floriculture.

1.	Greenhouse construction and heating,	6
2.	Propagation of greenhouse and other plants by seed, cuttings, grafting, etc.,	3
3.	Cultivation of rose, carnation, chrysanthemum and orchids,	12
4.	Propagation and care of greenhouse and bedding plants,	10

V. Floriculture—Concluded.

5.	Insects and fungi which attack greenhouse plants,	
	Total hours,	

VI. Market Gardening.

1.	Introduction, equipment, tools, manures, fertilizers, etc.,	
2.	Greenhouse construction and heating,	
3.	Forcing vegetables under glass,	
4.	Seed growing by the market gardener,	
5.	Special treatment required by each crop,	
6.	Insects and fungi, with remedies,	
	Total hours,	

BOTANY.

VII. Lectures on Injurious Fungi of the Farm, Garden, Greenhouse, Orchard and Vineyard.

1.	Introduction,	2
2.	Nature and structure of rusts,	4
3.	Nature and structure of smuts,	4
4.	Nature and structure of mildews,	4
5.	Nature and structure of rots,	4
6.	Beneficial fungi of roots,	2
7.	Edible mushrooms,	2
	Total hours,	22

VIII. Lectures and Demonstrations on "How Plants Grow."

1.	Introduction,	1
2.	The parts of a plant,	1
3.	Structure of the cell and plant in general,	3
4.	Functions of root, stem and leaves,	3
5.	Food of plant obtained from air,	3
6.	Food of plant obtained from soil,	3
7.	Transference and elaboration of food,	2
8.	Growth of plants,	2
9.	Effects of light, moisture, heat and cold,	2
10.	Root tubercles on pea and clover,	1
11.	Cross fertilization of flowers,	1
	Total hours,	22

CHEMISTRY.

IX. General Agricultural Chemistry.

1.	Introduction,	2
2.	The fourteen elements of agricultural chemistry,	1
3.	Rocks and soils,	8
4.	The atmosphere,	7
5.	The chemistry of crop-growing,	8
6.	Fertilizers,	8
7.	Animal chemistry,	8
	Total hours,	55

X. Chemistry of the Dairy.

1.	Introduction,	2
2.	The fourteen elements of agricultural chemistry,	14
3.	The physical properties of milk,	13
4.	Analysis of milk, butter, cheese and other dairy products,	13
5.	Chemistry of the manufacture of dairy products,	13
	Total hours,	55

ZOÖLOGY.

XI. Animal Life on the Farm.

Total hours, ... 22

XII. Insect Friends and Foes of the Farmers.

Total hours, ... 33

GRADUATE COURSE.

1. Honorary degrees will not be conferred.

2. Applicants will not be eligible to the degree of M.S. un they have received the degree of B.Sc. or its equivalent.

3. The faculty shall offer a course of study in each of following subjects: mathematics and physics; chemistry; agricu ure; botany; horticulture; entomology; veterinary. Upon satisfactory completion of any two of these the applicant sh receive the degree of M.S. This prescribed work may be done the Massachusetts Agricultural College or at any institution wh the applicant may choose; but in either case the degree shall conferred only after the applicant has passed an examination the college under such rules and regulations as may be prescrib

4. The degree of Doctor of Philosophy may be conferred up graduates of this college or other colleges of good standing w shall spend three years at this institution, taking chemistry, b any and entomology as their major and minor studies, if in t time the amount and quality of work done be satisfactory to professors in charge of the above-named departments.

5. Every student in the graduate course shall pay twenty-f dollars to the treasurer of the college before receiving the deg of M.S. or Ph.D.

TEXT-BOOKS.

GRAY — "Manual." American Book Company, New York.

DARWIN and ACTON — "Practical Physiology of Plants." Univers Press, Cambridge.

STRASBURGER — "Practical Botany." Swan, Sonnenschein & C London.

SORAUER — "Physiology of Plants." Longmans, Green & Co, N York and London.

CAMPBELL — "Structural and Systematic Botany." Ginn & C Boston.

KNOBEL — "Trees and Shrubs of New England." Bradlee Whidd Boston.

GREINER — "How to make the Garden pay." Wm. Maule, Phi delphia.

LONG — "Ornamental Gardening for Americans." Orange Ju Company, New York.

TAFT — "Greenhouse Construction." Orange Judd Company, N York.

VEED — "Insects and Insecticides." Orange Judd Company, New rk.

VEED — "Fungi and Fungicides." Orange Judd Company, New rk.

'ULLER — "Practical Forestry." Orange Judd Company, New rk.

IAYNARD — "Practical Fruit Grower." Orange Judd Company, New rk.

IcALPINE — "How to know Grasses by their Leaves." David iglas, Edinburgh.

ODEMAN — "The Spraying of Crops." Macmillan & Co., New k.

AUNDERS — "Insects injurious to Fruits." Lippincott & Co., ladelphia.

IORROW and HUNT — "Soils and Crops." Howard & Wilson Pub-ing Company.

IKMAN — "Manures and the Principles of Manuring." Wm. Black-od & Son, Edinburgh.

IILES — "Stock Breeding" D Appleton & Co., New York.

URTIS — "Horses, Cattle, Sheep and Swine." Orange Judd Com-y, New York.

ARRINGTON and WOLL — "Testing Milk and its Products" Men-a Book Company, Madison, Wis.

ON RICHTER — "A Text-book of Inorganic Chemistry." P. Blakis-Son & Co., Philadelphia.

IÜTER — "Analytical Chemistry." P. Blakiston, Son & Co., Phila-phia.

OSCOE — "Lessons in Elementary Chemistry." Macmillan & Co., v York.

ERNTHSEN and McGOWAN — "Text-book of Organic Chemistry" ckie & Son, London.

EYNOLDS — "Experimental Chemistry" Longmans, Green & Co., v York and London.

UTTON — "Volumetric Analysis." J. & A. Churchill, London.

ANA — "Manual of Determinative Mineralogy." John Wiley & s, New York.

ANA — "A Text-book of Elementary Mechanics for the Use of leges and Schools." John Wiley & Sons, New York.

AGE — "The Principles of Physics." Ginn & Co., Boston.

AUNCE — "Mechanical Drawing" Linus Faunce, Boston.

VELLS — "College Algebra" Leach, Shewell & Sanborn, Boston.

IESERVEY — "Meservey's Book-keeping, Single and Double Entry." mpson, Brown & Co., Boston.

VELLS — "Plane and Solid Geometry." Leach, Shewell & Sanborn, ton.

VELLS — "Essentials of Trigonometry." Leach, Shewell & Sanborn, ton

ILLESPIE — "A Manual on the Principles and Practice of Road king." A. S. Barnes & Co., New York.

MERRIMAN — "A Treatise on Hydraulics." John Wiley & Son New York.

MILLER — "A Treatise on Plane and Spherical Trigonometry Leach, Shewell & Sanborn, Boston.

RAYMOND — "A Text-book on Plane Surveying." American Boo Company, New York.

FAUNCE — "Descriptive Geometry." Ginn & Co., Boston.

MERRIMAN — "Text-book on Least Squares." John Wiley & Son New York.

MARTIN — "The Human Body" (briefer course). Henry Holt & C New York.

WALKER — "Political Economy" (briefer course). Henry Holt Co., New York.

WALKER — "The Industrial History of England." Methuen & C London.

WILSON — "The State." D. C. Heath, Boston.

GIBBINS — "A Short Constitutional History of England" Ginn Co., Boston.

GENUNG — "Outlines of Rhetoric." Ginn & Co., Boston.

WENTWORTH — "Irving's Sketch Book." Allyn & Bacon, Boston.

LONGFELLOW — "Poems." Houghton, Mifflin & Co , Boston.

PATTEE — "A History of American Literature." Silver, Burdett Co., Boston.

PANCOAST — "Representative English Literature." Henry Holt Co., New York.

JEVONS — "Logic." Science Primer Series. American Book Com pany, New York.

CORSON — "Selections from Chaucer's Canterbury Tales." Th Macmillan Company, New York.

ROLFE — "English Classics." Harper & Brothers, New York.

WHITNEY — "French Grammar." Henry Holt & Co., New York.

WHITNEY — "German Grammar." Henry Holt & Co., New York.

SHELDON — "Short German Grammar." D. C. Heath & Co., Bosto

HODGES — "Course in Scientific German." D C. Heath & C Boston.

PETTIT — "Elements of Military Science." The Tuttle, Morehou & Taylor Press, New Haven, Conn.

"Infantry Drill Regulations." Army and Navy Journal, New York

To give not only a practical but a liberal education is the aim each department, and the several courses have been so arrange as to best subserve that end. Exercises in composition an declamation are held throughout the course. The instruction agriculture and horticulture is both theoretical and practical, th lessons of the recitation room being practically enforced in th garden and field. Students are allowed to work for wages durin such leisure hours as are at their disposal. Under the act b which the college was founded, instruction in military tactics

erative, and each student, unless physically debarred,* is
ired to attend such exercises as are prescribed, under the
ction of a regular army officer stationed at the college.

FOUR-YEARS COURSE.

Admission.

ndidates for admission to the freshman class will be examined y and in writing upon the following subjects: English gram- geography, United States history, physiology, physical geog- y, arithmetic, the metric system, algebra (through quadratics), etry (two books) and civil government (Mowry's "Studies vil Government"). The standard required is 65 per cent. ach paper. Diplomas from high schools will *not* be received ace of examination. Examinations in the following subjects be taken a year before the candidate expects to enter college: ish grammar, geography, United States history, physical raphy and physiology. Satisfactory examination in a sub- ial part of the subjects offered will be required, that the cant may have credit for this preliminary examination.

ndidates for higher standing are examined as above, and also studies gone over by the class to which they desire admis-

one can be admitted to the college until he is sixteen years e. The regular examinations for admission are held at the ic Museum, at 9 o'clock A.M., on Thursday and Friday, 23 and 24, and on Tuesday and Wednesday, September 6 ; but candidates may be examined and admitted at any other in the year. For the accommodation of those living in the n part of the State, examinations will also be held at 9 k A.M., on Thursday and Friday, June 23 and 24, at Jacob er Hall, Boston University, 12 Somerset Street, Boston; and e accommodation of those in the western part of the State, same date and time, at the Sedgwick Institute, Great Bar- n, by James Bird. Two full days are required for examina- and candidates must come prepared to stay that length of

tificates of disability must be procured of Dr. Herbert B. Perry of Amherst.

WINTER COURSES.

For these short winter courses examinations are not requ
They commence the first Wednesday in January and end the
Wednesday in March. Candidates must be at least sixteen
of age. The doors of the college are opened to applicants
both sexes. The same privileges in regard to room and boar
obtain as with other students. Attendance upon general exe
is required. The usual fees for apparatus and material us
laboratory work will be required. Attendance upon military
is not expected.

ENTRANCE EXAMINATION PAPERS USED IN 1

The standard required is 65 per cent. on each paper.

Arithmetic and Metric System.

1. Divide the least common multiple of 7, 42, 6, 9, 1
630 by the greatest common divisor of 110, 140 and 680.

2. $\frac{\frac{1}{2} \text{ of } 7\frac{1}{2}}{\frac{3}{8} \text{ of } 15} + \frac{4\frac{3}{4} \times \frac{9}{10}}{11 \times 1\frac{1}{2}} = ?$ Give answer in lowest terms.

3. A speculator bought 48 bales of cotton, and afterwar
the whole for $2,008.80, losing 7%. What was the cost o
bale?

4. What must be the face of a note at 10 months, inte
8%, so that the proceeds may be $448.00?

5. $(2.8)^3 \div \sqrt{.117649} = ?$

6. What will be the weight in grams of the water contai
a rectangular vessel 2 m. $\times$ 9 cm. $\times$ 7 dm.?

7. How many pails of water are there in a tank 10 m.
long, 6 m. 2 dm. wide and 9 dm. 4 cm. deep, if the capac
the pail is 5 litres?

Algebra.

Resolve into prime factors —

1. (*a*) $(5x+8y)^2-(4x-3y)^2$.
   (*b*) $(2x+3y)(3x)-(2x+3y)(2y)$.
   (*c*) (x^2-7x+6).

2. A cistern could be filled with water by means of on
alone in six hours and by means of another pipe alone i
hours, and it could be emptied by a tap in twelve hours if t
pipes were closed. In what time will the cistern be filled
pipes and tap are all open?

$$\left.\begin{array}{l}\dfrac{12}{x}+\dfrac{8}{y}=8\\[2ex]\dfrac{27}{x}-\dfrac{12}{y}=3\end{array}\right\}\text{ solve for } x \text{ and } y.$$

. Find the square root of

$$9x+10-12x^{\frac{1}{2}}-4x^{-\frac{1}{2}}+x^{-1}.$$

. Rationalize the denominator of

$$\frac{25\sqrt{3}-4\sqrt{2}}{7\sqrt{3}-5\sqrt{2}}$$

. Divide $a^{\frac{2}{3}}+b^{\frac{2}{3}}-c^{\frac{2}{3}}+2a^{\frac{1}{3}}b^{\frac{1}{3}}$ by $a^{\frac{1}{3}}+b^{\frac{1}{3}}+c^{\frac{1}{3}}$.

$$\left.\begin{array}{l}x^2-2xy=5\\x^2+y^2=29\end{array}\right\}\text{ solve for } x \text{ and } y.$$

Geometry.

. Each side of an equilateral triangle is two feet; find its ude.

rove the following: —

The line joining the middle points of two sides of a triangle rallel to the third side and equal to one-half of it.

The perpendiculars at the middle points of the sides of a gle meet in a common point.

In the same circle, or equal circles, two central angles are e same ratio as the intercepted arcs. Give proof when the are incommensurable.

An inscribed angle is measured by one-half its intercepted Give proof when one side of the angle is a diameter.

United States History.

E. — Penmanship, spelling, capitalization and punctuation will be considered rmining the excellence of your paper.

Contrast the settlement of the Virginia colony at James- and that of the Massachusetts colony at Plymouth. Give of each settlement.

(*a*) Name the thirteen original States. (*b*) What were the ticles of Confederation," and what were their weak points? When was the Constitution adopted?

The causes, principal events and outcome of the French Indian War.

Give brief accounts of the following: (*a*) The Stamp Act. The Boston Massacre. (*c*) The Boston Tea Party.

Write a short account of the administration of Andrew son.

6. For what were the following men noted in the *legisla* history of our country: (*a*) Benjamin Franklin, (*b*) Patr Henry, (*c*) John Jay, (*d*) Alexander Hamilton, (*e*) James M roe, (*f*) Daniel Webster, (*g*) John C. Calhoun, (*h*) Abrah Lincoln, (*i*) Charles Sumner, (*j*) Grover Cleveland?

7–8. The Missouri Compromise. Give the cause, purport and effect.

9. A few words on the following engagements of the C War: (*a*) Farragut's attack on New Orleans. (*b*) The battle Gettysburg.

10. Name the Presidents that were elected for two terms.

Geography.

Note. — Penmanship, spelling, capitalization and punctuation will be consid in determining the excellence of your paper.

1. Draw a line from Boston to New Orleans. Through w States would the line pass?

2. Bound the United States of America.

3–4. A careful and comprehensive account of Mexico.

5. Locate: Corea, Amsterdam, Wales, Provincetown, Wars Poland, Calcutta, Sydney, Queenstown, Valparaiso.

6. Describe a journey eastward, by water, from Chicago Constantinople.

7–8. The East Indies: (*a*) names of the principal islan (*b*) geographical features; (*c*) people; (*d*) resources and pr ucts.

9. Name six republics on the earth.

10. The States bordering upon the Gulf of Mexico, and t capitals.

Physical Geography.

Note. — Penmanship, spelling, capitalization and punctuation will be consid in determining the excellence of your paper.

1. What are the tides? Where are they greatest, and wh least? What causes them? Tell the difference between flood high tides.

2. What is the Sargasso Sea? What causes it?

3. Name and describe the different kinds of clouds.

4. What is a volcano? What substances are thrown out d ing an eruption? What probably causes an eruption?

5. Suppose a vessel to sail from North Cape to Cape Ho through what zones and across what circles would she pa What ocean currents would she encounter? and state whether t would aid or retard her progress

Civil Government.

ote. — Penmanship, spelling, capitalization and punctuation will be consid- in determining the excellence of your paper.

. How does the form of the government of the town in which live differ from that of the government of the United States? town government of the same form as that of a city?

. Name the three kinds of colonial government found in erica prior to the Revolution. Show in what respects they ered from each other, and name the colonies that were under .

Who make the laws for the government of the town or city hich you live? What is the official name of the men whose it is to see that these laws are executed? By whom and how are these men chosen? Does the town have a written consti- on?

Who make the laws for the government of the State in h you live? Where and how often do these law-makers meet? hom are they chosen? How long do they hold office? What e official title of the chief executive officer of the State?

What is the Congress of the United States? Of how many es does it consist, and what is the name of each? How many has Massachusetts in each of these bodies? How and for long a time are these men chosen?

What is meant by an *executive* officer? What is the official of the chief executive officer of the United States? Explain ully how he is elected. For how long a time is he elected?

What is the Constitution of the United States? Who ed it? Where and in what year? In what year did it go effect? Name any of the objects for which the people of the ed States ordained and established the Constitution.

What is a tax? a poll tax? a property tax? a direct tax? direct tax? For what purposes may a town levy a tax upon itizens? How is the amount of each citizen's tax deter- d?

Why is an education a necessity in a republican govern- ? Why is it right to tax the citizens of a town for the sup- of public schools? What provision for the support of public ls in the new States of the Northwest did Congress make? briefly about the public schools of the town in which you

Physiology.

Note. — Penmanship, spelling, capitalization and punctuation will be c ered in determining the excellence of your paper.

1. Name and locate the cranial bones.

Give a careful description of the skeleton of the trunk.

2. Describe the mechanics of respiration.

How does air once breathed differ from pure air?

3. Give the several functions of the skin.

Tell what you know of the hygiene of the skin.

4. Give the bodily location and the uses of the follo organs: the aorta, the optic nerve, the spleen, the larynx an pharynx.

5. Suppose the hand to touch a hot stove, it is drawn aw quickly as not to be injured; how is this done, and by what me

English Grammar and Composition.

Note. — Penmanship, spelling, capitalization and punctuation will be c ered in determining the excellence of your paper.

1. Name every word in the following sentence; *i.e.*, gi part of speech: —

"The closing years of the nineteenth century will be re bered by Americans as those in which the business prosper the country sunk to a remarkably low level."

2. Select from the above (*a*) all words in the *nominative* (*b*) all those in the *objective* case. (*c*) Are there any of the *sessive* case in the sentence?

3. Give the principal parts of: recline, fly, beat, fight,

4. Analyze the following: —

"The tramp who came to our door last evening aroused curiosity; and next morning my father tried to find out the from which the man had come."

5. Write a sentence upon college education; one upon culture.

Note. — Each sentence must contain at least twenty words.

6. Define the paragraph. How does it differ from the sent

7–9. Write three paragraphs upon one of the following jects: (*a*) Why I come to college; (*b*) Longfellow's "Ev line;" (*c*) John G. Whittier; (*d*) General Grant.

10. State clearly and fully the work you have done durin past two years, in school and out, in grammar and rhe Where books can be named, do so.

DEGREES.

'hose who complete the four-years course receive the degree of helor of Science, the diploma being signed by the governor of ssachusetts, who is the president of the corporation.

egular students of the college may also, on application, become nbers of Boston University, and upon graduation receive its oma in addition to that of the college, thereby becoming en- d to all the privileges of its alumni.

hose completing the prescribed graduate course receive the ee of Master of Science or Doctor of Philosophy.

EXPENSES.

Tuition in advance: —			
term,	$30 00		
er term,	25 00		
mer term,	25 00		
		$80 00	$80 00
n rent, in advance, $8 to $16 per term,		24 00	48 00
d, $2.50 to $5 per week,		95 00	190 00
. $5 to $15,		5 00	15 00
hing, 30 to 60 cents per week,		11 40	22 80
ary suit,		15 75	15 75
Expenses per year,		$231 15	$371 55

oard in clubs has been about $2.45 per week; in private fami- $4 to $5. The military suit must be obtained immediately entrance at college, and used in the drill exercises prescribed. following fees will be charged for the maintenance of the al laboratories: chemical, $10 per term used; zoölogical, $4 term used; botanical, $1 per term used by sophomore class, per term used by senior class; entomological, $2 per term . Some expense will also be incurred for lights and text- s. Students whose homes are within the State of Massachu- can in most cases obtain a scholarship by applying to the tor of the district in which they live.

THE LABOR FUND.

ne object of this fund is to assist those students who are ndent either wholly or in part on their own exertions, by fur- ng them work in the several departments of the college. The est opportunity for such work is found in the agricultural and

horticultural departments. Application should be
William P. Brooks and Samuel T. Maynard, respec
of said departments. Students desiring to avail th
benefits must bring a certificate signed by one of t
the town in which they are resident, certifying to th
require aid.

ROOMS.

All students, except those living with parents
will be required to occupy rooms in the college dor
For the information of those desiring to carpet t
following measurements are given: in the new sout
study rooms are about fifteen by fourteen feet, with
feet four inches by three feet; and the bedrooms
two inches by eight feet five inches. This buildi
steam. In the north dormitory the corner rooms
fifteen feet, and the annexed bedrooms eight by
inside rooms are thirteen and one-half by fourtee
feet, and the bedrooms eight by eight feet. A co
nished with each room. Aside from this, all ro
nished. Mr. Thomas Canavan has the general sup
the dormitories, and all correspondence relative to
rooms should be with him.

SCHOLARSHIPS.

Established by Private Individual

Mary Robinson Fund of one thousand dollars,
Miss Mary Robinson of Medfield.

Whiting Street Fund of one thousand dollars,
Whiting Street, Esq., of Northampton.

Henry Gassett Fund of one thousand dollars,
Henry Gassett, Esq., of North Weymouth.

The income of the above funds is assigned by
worthy students requiring aid.

Congressional Scholarships.

The trustees voted in January, 1878, to esta
scholarship for each of the congressional districts
Application for such scholarships should be mad
sentative from the district to which the applicant
selection for these scholarships will be determined

Congress may prefer; but, where several applications are sent from the same district, a competitive examination would seem be desirable. Applicants should be good scholars, of vigorous nstitution, and should enter college with the intention of remain- ; through the course.

State Scholarships.

The Legislature of 1883 passed the following resolve in favor the Massachusetts Agricultural College: —

Resolved, That there shall be paid annually, for the term of four years, m the treasury of the Commonwealth to the treasurer of the Massa- usetts Agricultural College, the sum of ten thousand dollars, to enable trustees of said college to provide for the students of said institution theoretical and practical education required by its charter and the of the United States relating thereto.

Resolved, That annually, for the term of four years eighty free scholar- ps be and hereby are established at the Massachusetts Agricultural lege, the same to be given by appointment to persons in this Com- nwealth. after a competitive examination, under rules prescribed by president of the college, at such time and place as the senator then office from each district shall designate; and the said scholarships ll be assigned equally to each senatorial district. But, if there shall less than two successful applicants for scholarships from any sena- ial district, such scholarships may be distributed by the president of college equally among the other districts as nearly as possible; but applicant shall be entitled to a scholarship unless he shall pass an mination in accordance with the rules to be established as herein- ore provided.

The Legislature of 1886 passed the following resolve, making petual the scholarships established: —

Resolved, That annually the scholarships established by chapter forty- of the resolves of the year eighteen hundred and eighty-three be en and continued in accordance with the provisions of said chapter.

In accordance with these resolves, any one desiring admission to college can apply to the senator of his district for a scholar- p. Blank forms of application will be furnished by the presi- nt.

EQUIPMENT.

Agricultural Department.

The Farm. — Among the various means through which instruc- n in agriculture is given, none exceeds in importance the farm. e part which is directly under the charge of the professor of

agriculture comprises about one hundred and fifty acres of im proved land and thirty acres of woodland. Of the improved land about thirty acres are kept permanently in grass.

The rest of the farm is managed under a system of rotation, a parts being alternately in grass and hoed crops. All the ordinar crops of this section are grown, and many not usually seen upo Massachusetts farms find a place here. Our large stock of milc cows being fed almost entirely in the barn, fodder crops occupy prominent place. Experiments of various kinds are continuall under trial; and every plat is staked, and bears a label statin variety under cultivation, date of planting, and manures and fe tilizers used.

Methods of land improvement are constantly illustrated her tile drainage especially receiving a large share of attention. The are now some nine miles of tile drains in successful and very sa isfactory operation upon the farm. Methods of clearing land stumps are also illustrated, a large amount of such work havin been carried on during the last few years.

In all the work of the farm the students are freely employe and classes are frequently taken into the fields; and to the lesson to be derived from these fields the students are constantly referre

The Barn and Stock. — Our commodious barns contain a lar stock of milch cows, many of which are grades; but the followin pure breeds are represented by good animals, viz., Holstei Friesian, Ayrshire, Jersey, Guernsey, Aberdeen-Angus and Shor horn. Experiments in feeding for milk and butter are continual in progress. We have a fine flock of Southdown sheep. Swi are represented by the Chester White, Poland China, Cheshir Berkshire and Tamworth breeds. Besides work horses, we have number of pure-bred Percherons, used for breeding as well for work; and a fine pair of French Coach colts.

The barn is a model of convenience and labor-saving arrang ments. It illustrates different methods of fastening animal various styles of mangers, watering devices, etc. Connected wi it are commodious storage rooms for vehicles and machines. contains silos and a granary. A very large share of the work performed by students, and whenever points require illustratio classes are taken to it for that purpose.

Dairy School. — Connecting with the barn is a wing providin accommodation for practical and educational work in dairyin The wing contains one room for heavy dairy machinery, anoth for lighter machinery, both large enough to accommodate vario styles of all prominent machines; a large ice-house, a cold-stora

oom and a room for raising cream by gravity methods, a class oom and a laboratory. The power used is an electric motor. This department is steam heated and piped for hot and cold water nd steam. In this department has been placed a full line of nodern dairy machinery, so that we are able to illustrate all the arious processes connected with the creaming of milk, its prepa-ation for market and the manufacture of butter. Special in-truction in such work is offered in the dairy course.

Equipment of Farm. — Aside from machines and implements enerally found upon farms, the more important of those used pon our farm and in our barn which it seems desirable to men-ion are the following: reversible sulky plough, broadcast fertilizer istributer, manure spreader, grain drill, horse corn planter, potato lanter, wheelbarrow grass seeder, hay loader, potato digger and odder cutter and crusher. It is our aim to try all novelties as ney come out, and to illustrate everywhere the latest and best nethods of doing farm work.

Lecture Room. — The agricultural lecture room in south college s well adapted to its uses. It is provided with numerous charts nd lantern slides, illustrating the subjects taught. Connected ith it are two small rooms at present used for the storage of lustrative material, which comprises soils in great variety, all nportant fertilizers and fertilizer materials, implements used in ne agriculture of our own and other countries, and a collection of rasses and forage plants, grains, etc.

A valuable addition to our resources consists of a full series f Landsberg's models of animals. These are accurate models of elected animals of all the leading breeds of cattle, horses, sheep nd swine, from one-sixth to full size, according to subject. We re provided with a complete collection of seeds of all our common rasses and the weeds which grow in mowings, and have also a arge collection of the concentrated food stuffs. All these are ontinually used in illustration of subjects studied.

Museum. — A beginning has been made towards accumulating naterials for an agricultural museum. This is to contain the ocks from which soils have been derived, soils, fertilizer materials nd manufactured fertilizers, seeds, plants and their products, tuffed animals, machines and implements. It is expected to nake this collection of historical importance by including in it old ypes of machines and implements, earlier forms of breeds, etc. For lack of room the material thus far accumulated is stored in a umber of scattered localities, and much of it where it cannot be atisfactorily exhibited.

Botanical Department.

Course of Study. — This department is well equip
comprehensive course in most of the subjects of
course aims to treat of all the more important featu
with the study of plants which have a close beari
culture, without at the same time deviating from a s
logical plan. Throughout the entire course the obje
of teaching are followed, and the student is consta
with an abundance of plant material for practical st
with an elaborate series of preserved specimens f
and comparison. In the freshman year the study
and systematic botany is pursued, with some observa
fertilization. This is followed in the first term of t
year by the systematic study of grasses, trees and sh
during the winter term by an investigation into th
structure of the plant. The senior year is given
cryptogamic and physiological botany. This inclu
our common plant diseases, and the simple function
which it is essential for the agriculturist to become f

The Botanical Museum contains the Knowlton
over ten thousand species of phanerogamous and th
togamous plants; about five thousand species of fu
eral collections of lichens and mosses, including the
man, Frost, Denslow, Cummings, Müller and Scha
contains a large collection of native woods, cut so as
individual structure; numerous models of native frui
of abnormal and peculiar forms of stems, fruits, veg
many interesting specimens of unnatural growths
plants, natural grafts, etc.; together with models f
the growth and structure of plants, and including a
squash which raised by the expansive force of its
the enormous weight of five thousand pounds.

The Botanical Lecture Room, in the same buildin
with diagrams and charts of over three thousand fig
ing structural, systematic and physiological botany.

The Botanical Laboratory has provision for thirty
to work at one time. Each student is provided w
wherein he can dispose of his equipment necessa
The laboratory is equipped with Leitz', Reichert's
Lomb's, Beck's, Queen's and Tolles' compound micr
objectives varying from four inch to one-fifteenth inch
It also contains four induction coils, including a Du

luction apparatus and rheocord, a Lippmann capillary electrom-r, and various other forms of electrical appliances especially rised for studying the influence of electricity upon the growth plants. There are also Thoma, Minot and Beck microtomes, elf-registering thermometer and hygrometer, a Wortmann im-ved clinostat and also one of special construction, an Arthur trifugal apparatus with electric motor, various forms of self-istering appliances for registering the growth of plants, includ- a Pfeffer-Baranetsky electrical self-registering auxanometer, a h's arc-auxanometer, a horizontal reading microscope (Pfeffer lel), various kinds of dynamometers of special construction, piration appliances, mercurial sap and vacuum gauges, manom-rs, gas and exhaust chambers, besides various other appliances work and demonstration in plant physiology. The laboratory lso provided with an Eastman landscape camera, a Bausch Lomb micro-photographic camera, and a dark closet equipped photographic and other kinds of work.

HORTICULTURAL DEPARTMENT.

reenhouses. — To aid in the instruction in botany, as well as loriculture and market gardening, the glass structures contain rge collection of plants of a botanic and economic value, as l as those grown for commercial purposes. They consist of large octagons, forty by forty feet, with sides twelve feet 1 and a central portion over twenty feet high, for the growth arge specimens, like palms, tree ferns, the bamboo, banana, va, olive, etc.; a moist stove twenty-five feet square; a dry e of the same dimensions; a rose room, twenty-five by twenty ; a room for aquatic plants, twenty by twenty-five feet; a n for ferns, mosses and orchids, eighteen by thirty feet; a e propagating house, fifty by twenty-four feet, fitted up with ches sufficient in number to accommodate fifty students at work ne time; a vegetable house, forty-two by thirty-two feet; a e propagating house, thirty-six by seventy-five feet, for the ving of carnations, violets and bedding plants; a cold grapery, iteen by twenty-five feet. To these glass structures are at-ied three work rooms, equipped with all kinds of tools for nhouse work. In building these houses as many as possible he principles of construction, heating, ventilation, etc., have 1 incorporated for the purposes of instruction.

rchards. — These are extensive, and contain nearly all the iable leading varieties, both old and new, of the large fruits, ving under various conditions of soil and exposure.

Small Fruits. — The small-fruit plantations contain a large number of varieties of each kind, especially the new and promising ones, which are compared with older sorts, in plots and in field culture. Methods of planting, pruning, training, cultivation, study of varieties, gathering, packing and shipping fruit, etc., are taught by field exercises, the students doing a large part of the work of the department.

Nursery. — This contains more than five thousand trees, shrubs and vines in various stages of growth, where the different methods of propagation by cuttings, layers, budding, grafting, pruning and training are practically taught to the students.

Garden. — All kinds of garden and farm-garden crops are grown in this department, furnishing ample illustration of the treatment of market-garden crops. The income from the sales of trees, plants, flowers, fruit and vegetables aids materially in the support of the department, and furnishes illustrations of the methods of business, with which all students are expected to become familiar.

Forestry. — Many kinds of trees suitable for forest planting are grown in the nursery, and plantations have been made upon the college grounds and upon private estates in the vicinity, affording good examples of this most important subject. A large forest grove is connected with this department, where the methods of pruning trees and the management and preservation of forests can be illustrated. In the museum and lecture room are collections of native woods, showing their natural condition and peculiarities; and there have been lately added the prepared wood sections of R. B. Hough, mounted on cards for class-room illustration.

Ornamental trees, shrubs and flowering plants are grouped about the grounds in such a way as to afford as much instruction as possible in the art of landscape gardening. All these, as well as the varieties of large and small fruits, are marked with conspicuous labels, giving their common and Latin names, for the benefit of the students and the public.

Tool House. — A tool house, thirty by eighty feet, has been constructed, containing a general store-room for keeping small tools; a repair shop with forge, anvil and work-bench; and a carpenter shop equipped with a large Sloyd bench and full set of tools. Under one-half of this building is a cellar for storing fruit and vegetables. In the loft is a chamber, thirty by eighty feet, for keeping hot-bed sashes, shutters, mats, berry crates, baskets and other materials when not in use.

Connected with the stable is a cold-storage room, with an ice-chamber over it, for preserving fruit, while the main cellar underneath the stable is devoted to the keeping of vegetables.

All the low land south of the greenhouses has been thoroughly nderdrained and put into condition for the production of any garen or small fruit crop.

DEPARTMENT OF ZOÖLOGY.

The work in this department begins in the winter term of the ophomore year with human anatomy and physiology, the study of hich not only serves as an introduction to zoölogy and veterinary ience, but also gives the student a knowledge of the structure nd uses of the different organs of the human body and the laws f health. In the fall and winter terms the members of the junior ass take zoölogy, which is taught by means of lectures and boratory work. In the laboratory each student is required to issect and study a series of typical animals, making drawings of e various organs. During the spring term of this year a course f lectures is given on insects in general, their classification and abits and the various methods of destroying those that are injurius, and more or less time in this connection is devoted to laboraory and field work.

There is a most excellent and carefully arranged museum conected with this department, in which are exhibited, as far as ossible, all the native animals of this Commonwealth, together ith such species from other parts of the world as are necessary give completeness or for the instruction of the students. This useum furnishes specimens for illustration in the lectures before e classes, and also for general information to visitors as well as embers of the college.

During the senior year such members of this class as elect dvanced entomology take a course of more technical lectures, which the following subjects relating to insects are considered uite at length: external and internal anatomy, embryology, transormations, duration of life, luminosity of insects, the color of sects, parasitic insects, diseases of insects, number of insects existence, geographical and geological distribution of insects, sect architecture, fertilization of plants by insects, economic ntomology, bee-keeping and the literature of insects. The laboatory work of this year consists in part of dissections of the aterpillar, pupa and imago stages of insects, and a critical study f the external anatomy of species of each of the orders of sects, followed by the exercise of determining a group of insects each order; and, finally, each student is required to prepare a esis on some insect or group of insects pertaining to the busiess in which he intends to engage. He is asked at the beginning f the year what business he intends to follow after graduation,

and is then advised to prepare his thesis on those insects with which he will most have to deal in the business he has selected. In the preparation of this thesis the work is carried on in the most approved methods, so that he may obtain the most scientific and at the same time practical knowledge of the subject; in fact, the is taught such methods of investigation that, if new insec pests appear on his crops, he will know how to properly investigate them and discover the best and cheapest methods for their destruction. If this thesis when completed contains information of public interest, whether of an economic character or otherwise, it is published, with whatever illustrations are necessary.

This course is primarily for the student of agriculture or horticulture, but, when taken in connection with botany and chemistry, is especially adapted to one wishing to fit himself as a teacher of science in our public schools, or to one intending to study medicine, but in this case his laboratory work would be devoted mainly to histology.

This department is now prepared for and is receiving graduates from this and other colleges, who wish to continue the study of entomology beyond what they were able in their undergraduate course. These advanced studies will fit them for positions in the experiment stations or as State entomologists, and also give them most excellent training as teachers in our high schools and colleges.

Veterinary Department.

This department is well equipped with the apparatus necessary to illustrate the subject in the class room.

It consists of an improved Auzoux model of the horse, imported from Paris, constructed so as to separate and show in detail the shape, size, structure and relations of the different parts of the body; two *papier-maché* models of the hind legs of the horse, showing diseases of the soft tissues, — wind-galls, bog spavins, etc., also the diseases of the bone tissues, — splints, spavins and ringbones; two models of the foot, one according to Bracy Clark's description, the other showing the Charlier method of shoeing and the general anatomy of the foot; a full-sized model of the bones of the hind leg, giving shape, size and position of each individual bone; thirty-one full-sized models of the jaws and teeth of the horse and fourteen of the ox, showing the changes which take place in these organs as the animals advance in age.

There is an articulated skeleton of the famous stallion, Blackhawk, a disarticulated one of a thoroughbred mare, besides one each of the cow, sheep, pig and dog; two prepared dissections of

the fore and hind legs of the horse, showing position and relation of the soft tissues to the bones; a *papier-maché* model of the uterus of the mare and of the pig; a gravid uterus of the cow; a wax model of the uterus, placenta and fœtus of the sheep; showing the position of the fœtus and the attachment of the placenta to the walls of the uterus.

In addition to the above there is a growing collection of pathological specimens of both the soft and osseous tissues, and many parasites common to the domestic animals. A collection of charts and diagrams especially prepared for the college is used in connection with lectures upon the subject of anatomy, parturition and conformation of animals.

Through the kindness of Mr. Henry Adams of Amherst the department has received a large sample collection of the various drugs used in the treatment of the diseases of the domestic animals.

For the benefit of the students, sick or diseased animals are frequently shown them, and operations performed in connection with the class-room work. For the use of the instructor of this department a laboratory has been provided in the old chapel building. It has been equipped with the apparatus necessary for the study of histology, pathology and bacteriology, consisting in part of four improved Zeiss microscopes with one-eighteenth and one-twelfth inch oil immersion objectives, together with the lower powers; a Lautenschlager's incubator and hot-air sterilizer; an Arnold's steam sterilizer and a Bausch and Lomb improved laboratory microtome. This apparatus is used for the preparation of material for the class room and for general investigation.

Mathematical Department.

At first glance it might appear that mathematics would play a very small part in the curriculum of an agricultural college, and, while it is true that its chief object is of a supplementary nature, it is equally true that, entirely aside from its value as a means of mental discipline, mathematics has a well-defined and practical object to accomplish. In this day of scientific experiment, observation and research on the farm, the advantages of a thorough knowledge of the more elementary branches of mathematics, general physics and engineering must be more than ever apparent; and it is to meet the needs of the agricultural college student in these lines that the work in the mathematical department has been planned.

The mathematics of the freshman, sophomore and junior years are required, those of the senior year elective.

A glance at the schedule of studies will show the sequence of subjects: book-keeping, algebra, geometry and mechanical drawing in the freshman year; trigonometry, mechanical drawing and plane surveying — the latter embracing lectures and field work in elementary engineering, the use of instruments, computation of areas, levelling, etc. — in the sophomore year; general physics with work in laboratory — including mechanics, electricity, sound, light and heat — and descriptive geometry or advanced mechanical drawing in the junior year; and, finally, two electives in the senior year, — mathematics and engineering, respectively.*

The mathematical option includes the following subjects: fall term, plane analytic geometry, embracing a study of the equations and properties of the point, line and circle, and of the parabola, ellipse and hyperbola; winter term, differential calculus; and summer term, integral calculus.

The senior engineering option is designed to give to the student the necessary engineering training to enable him to take up and apply, on the lines of landscape engineering and the development of property, his knowledge of landscape gardening, agriculture, forestry, botany and horticulture. It embraces a course of lectures, recitations and field work on the following subjects: topography, railroad curves, earth work, construction and maintenance of roads, water works and sewerage systems, elementary structures, elementary mechanism, etc.

It is believed that the engineering elective will equip the student to enter a comparatively new field, that of landscape engineering, which is coming more and more prominently before the public attention; for, with the increasing consideration which is being paid to the public health and the development and beautifying of our towns and cities, come fresh needs and opportunities.

Chemical Department.

Instruction in general agricultural and analytical chemistry and mineralogy is given in the laboratory building. Thirteen commodious rooms, well lighted, ventilated and properly fitted, are occupied by the chemical department.

The lecture room, on the second floor, has ample seating capacity for seventy students. Immediately adjoining it are four smaller rooms, which serve for storing apparatus and preparing material for the lecture table.

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* While these two electives are entirely distinct, the student electing engineering is strongly advised to elect mathematics also.

The laboratory for beginners is a capacious room on the first floor. It is furnished with forty working tables. Each table is provided with sets of wet and dry re-agents, a fume chamber, water, gas, drawer and locker, and apparatus sufficient to render the student independent of carelessness or accident on the part of others working near by; thus equipped, each worker has the opportunity, under the direction of an instructor, of repeating the processes which he has previously studied in the lecture room, and of carrying out at will any tests which his own observation may suggest.

A systematic study of the properties of elementary matter is here taken up, then the study of the simpler combinations of the elements and their artificial preparation; then follows qualitative analysis of salts, minerals, soils, fertilizers, animal and vegetable products.

The laboratory for advanced students has tables for thirty workers, with adequate apparatus. This is for instruction in the chemistry of various manufacturing industries, especially those of agricultural interest, as the production of sugar, starch, fibres and dairy products; the preparation of plant and animal foods, their digestion, assimilation and economic use; the official analysis of fertilizers, fodders and foods; the analysis of soils and waters, of milk, urine and other animal and vegetable products.

The balance room has four balances and improved apparatus for determining densities of solids, liquids and gases.

Apparatus and Collections. — Large purchases of apparatus require to be made. Deficiencies caused by the wear and breakage of several years need to be supplied and the original outfit increased. The apparatus includes balances, a microscope, spectroscope, polariscope, photometer, barometer and numerous models and sets of apparatus. The various rooms are furnished with an extensive collection of industrial charts. A valuable and growing collection of specimens and samples, fitted to illustrate different subjects taught, is also provided. This includes rocks, minerals, soils, raw and manufactured fertilizers, foods, including milling products, fibres and other vegetable and animal products and artificial preparations of mineral and organic compounds. Series of preparations are used for illustrating the various stages of different manufactures from raw materials to finished products.

Library.

This now numbers 18,497 volumes, having been increased during the year, by gift and purchase, 687 volumes. It is placed in the lower hall of the chapel-library building, and is made available to

the general student for reference or investigation. It is especially valuable as a library of reference, and no pains will be spared to make it complete in the departments of agriculture, horticulture, botany and the natural sciences. It is open a portion of each day for consultation, and an hour every evening for the drawing of books.

PRIZES.

Burnham Rhetorical Prizes.

These prizes are awarded for excellence in declamation, and are open to competition, under certain restrictions, to members of the sophomore and freshman classes.

Flint Prizes.

Mr. Charles L. Flint of the class of 1881 has established two prizes, one of thirty dollars and another of twenty dollars, to be awarded, at an appointed time during commencement week, to the two members of the junior class who may produce the best orations. Excellence in both composition and delivery is considered in making the award.

Grinnell Agricultural Prizes.

Hon. William Claflin of Boston has given the sum of one thousand dollars for the endowment of a first and second prize, to be called the Grinnell agricultural prizes, in honor of George B. Grinnell, Esq., of New York. These two prizes are to be paid in cash to those two members of the graduating class who may pass the best written and oral examination in theoretical and practical agriculture.

Hills Botanical Prizes.

For the best herbarium collected by a member of the class of 1898 fifteen dollars is offered, and for the second best a prize of ten dollars; also a prize of five dollars for the best collection of dried plants from the college farm.

The prizes in 1897 were awarded as follows: —

Burnham Rhetorical Prizes: Edwin M. Wright (1899), first; Warren E. Hinds (1899), second; Allen L. March (1900), first; Francis G. Stanley (1900), second.

Flint Oratorical Prizes: Randall D. Warden (1898), first; John P. Nickerson (1898), second.

Grinnell Agricultural Prizes: Liberty L. Cheney (1897), first; Philip H. Smith, Jr. (1897), second.

Hills Botanical Prizes: John M. Barry (1897), first; Clayton F. Palmer (1897), second.

Prize in Drawing, given by William H. Armstrong, '99; Edwin K. Atkins (1900).

Senior Prizes, given by Charles S. Crocker, '89, and Henry L. Russell, '90; best thesis, James L. Bartlett; best appearance, Charles I. Goessmann.

RELIGIOUS SERVICES.

Students are required to attend prayers every week-day at 8 A.M. and public worship in the chapel every Sunday at 10.30 A.M. Further opportunities for moral and religious culture are afforded by a Bible class taught by one of the professors during the hour preceding the Sunday morning service and by religious meetings held on Sunday afternoon and during the week, under the auspices of the College Young Men's Christian Association.

LOCATION.

Amherst is on the New London Northern Railroad, connecting at Palmer with the Boston & Albany Railroad, and at Miller's Falls with the Fitchburg Railroad. It is also on the Central Massachusetts Railroad, connecting at Northampton with the Connecticut River Railroad and with the New Haven & Northampton Railroad.

The college buildings are on a healthful site, commanding one of the finest views in New England. The large farm of three hundred and eighty-three acres, with its varied surface and native forests, gives the student the freedom and quiet of a country home.

REPORTS.

GIFTS.

From MASSACHUSETTS SOCIETY FOR PROMOTING AGRICULTURE, one hundred dollars to be distributed in prizes in the Dairy School.

J. D. W. FRENCH of Boston, seven volumes Hough's "American Woods."

JOHN A. CUTTER (M. A. C., '82) of New York, forty-five volumes medical works.

FREDERICK W. MORRIS (M. A. C., '72) of New York, forty-four volumes miscellaneous works.

CREAMERY PACKAGE MANUFACTURING Co., of Chicago, Ill., Disbrow combined churn and butter worker.

F. B. FARGO & Co. of Lake Mills, Wis., Fargo combined churn and butter worker.

I. S. JOHNSON & Co. of Boston, two large cans Sheridan's condition powders.

L. H. REED of Grand Rapids, Mich., seed of Panicum crus-galli gigantic.

ROGERS & HUBBARD COMPANY of Middletown, Conn., one hundred pounds raw knuckle bone flour.

BRADLEY FERTILIZER COMPANY of Boston, two hundred pounds extract fine-ground South Carolina rock, five hundred pounds soft Florida rock, two hundred pounds hard Florida rock, two hundred pounds dissolved bone meal, one hundred pounds steamed bone meal and two hundred pounds acid phosphate.

BARTELEDES & Co. of Lawrence, Kansas, seed of Idaho field pea, white Kaffir corn, red Kaffir corn, black chaff Kaffir corn or African millet, yellow millo maize, black rice corn, Jerusalem corn, brown Dourha, Brazilian stooling flour corn.

UNITED STATES DEPARTMENT OF AGRICULTURE of Washington, D.C., seed of many varieties of grasses and alfalfa.

HERBERT MYRICK (M. A. C., '82) of Springfield, "Sugar, a New and Profitable Industry in the United States."

From SAMUEL B. GREEN (M. A. C., '79) of St. Anthony Park, Minn., "Vegetable Gardening."

HERBERT S. CARRUTH (M. A. C., '75) of Ashmont, "George Washington;" "True George Washington."

Hon. GEORGE F. HOAR of Washington, D.C., fifteen volumes government reports.

J. WILLARD BROWN of Boston, "Signal Corps of the United States in the War of the Rebellion."

JOHN F. WINCHESTER (M. A. C., '75) of Lawrence, "Bovine Diphtheria."

RIEHLÉ Co. of Pennsylvania, "Digest of Physical Tests."

JAMES C. HOUGHTON of Montpelier, Vt., "Cambridge of 1896."

CHARLES I. GOESSMANN (M. A. C., '97) of Amherst, "Introduction to General Chemistry;" "True Atomic Weight of the Chemical Elements;" "Literary History of the American Revolution."

Miss ELEANOR A. ORMEROD of Spring Grove, England, "Twentieth Report of Observations on Injurious Insects."

JOSEPH E. POND, Esq., of North Attleborough, four volumes bee journals.

WILLIAM H. CALDWELL (M. A. C., '87) of Peterboro, N.H., "Herd Register American Guernsey Cattle Club."

CHARLES L. FLINT (M. A. C., '81) of Brookline, "Reports Boston Transit Commission."

TREASURER'S REPORT.

Report of George F. Mills, *Treasurer of Massachusetts Agricultural College, from Jan. 1, 1897, to Jan. 1, 1898.*

	Received.	Paid.
Cash on hand Jan. 1, 1897,	$4,309 98	-
State treasurer,	15,333 33	-
Term bill,	3,213 48	$757 28
Salary,	250 00	26,987 40
Horticultural department,	4,495 85	6,366 70
Farm,	5,810 00	11,352 98
Expense,	1,410 00	9,163 19
Endowment fund,	11,791 97	-
State scholarship fund,	15,000 00	-
Labor fund,	5,000 00	5,849 65
Botanical laboratory,	65 00	48 46
Chemical laboratory,	585 04	478 17
Entomological laboratory,	30 00	5 76
Zoölogical laboratory,	32 00	45 95
Grinnell prize fund,	40 00	35 00
Gassett scholarship fund,	42 50	80 00
Whiting street fund,	51 05	30 00
Mary Robinson fund,	38 84	55 00
Burnham emergency fund,	129 04	80 00
Hills fund,	356 16	292 36
Library fund,	421 98	221 06
Extra instruction,	-	288 00
Advertising,	-	677 38
Dairy school,	558 78	1,241 58
Electric equipment,	754 92	3,132 33
Insurance,	-	478 57
Investment, N. Y. C. & H. R. R. R.,	4 00	-
Burnham emergency fund,	2,000 00	-
Cash on hand Jan. 1, 1898,	-	4,054 10
	$71,720 92	$71,720 92

This is to certify that I have this day examined the accounts of George F. Mills, treasurer of Massachusetts Agricultural College, from Jan. 1, 1897, to Jan. 1, 1898, and find the same correct, properly kept, and all disbursements vouched for, the balance in the treasury being four thousand and fifty-four dollars and ten cents ($4,054.10), which sum is shown to be in the hands of the treasurer.

CHARLES A. GLEASON, *Auditor.*

Amherst, Dec. 27, 1897.

Cash Balance, as shown by the Treasurer's Statement, belongs to the Following Accounts:

Hills fund,	$254 14
Burnham emergency fund,	49 04
Grinnell prize fund,	25 00
Gassett scholarship fund,	23 52
Whiting Street fund,	10 46
Mary Robinson fund,	4 76
General fund of the college,	3,687 18
	$4,054 10

Bills receivable Jan. 1, 1898.

Term bill,	$737 14
Horticultural department,	335 34
Farm,	898 22
Expense,	69 02
Labor fund,	7 23
Electric equipment,	145 95
Botanical laboratory,	32 50
Chemical laboratory,	294 00
Entomological laboratory,	6 00
Zoölogical laboratory,	68 00
	$2,593 40

Bills payable Jan. 1, 1898.

Term bill,	$43 23
Horticultural department,	438 44
Farm,	2,405 24
Expense,	567 69
Chemical laboratory,	89 08
Zoölogical laboratory,	27 45
Hills fund,	45 81
Insurance,	18 00
	$3,634 94

Inventory — real estate.

Land (Estimated Value).

College farm,	$37,000 00	
Pelham quarry,	500 00	
Bangs place,	1,750 00	
Clark place,	4,500 00	
		$43,750 00

Buildings (Estimated Value).

Drill hall,	$5,000 00	
Powder house,	75 00	
Gun shed,	1,500 00	
Stone chapel,	30,000 00	
South dormitory,	35,000 00	
		71,575 00
Amount carried forward,		$115,325 00

Amount brought forward,		$115,325 00
North dormitory,	$25,000 00	
Chemical laboratory,	8,000 00	
Entomological laboratory,	3,000 00	
Farm house,	2,000 00	
Horse barn,	5,000 00	
Farm barn and dairy school,	33,000 00	
Graves house and barn,	2,500 00	
Boarding house,	2,000 00	
Botanic museum,	5,500 00	
Botanic barn,	2,500 00	
Tool house,	2,000 00	
Durfee plant house and fixtures,	13,000 00	
Small plant house, with vegetable cellar and cold grapery,	4,700 00	
President's house,	6,500 00	
Dwelling houses, purchased with farm,	5,000 00	
		119,700 00
		$235,025 00

PERSONAL PROPERTY.

Electric equipment,	$6,000 00
Electric supplies,	88 59
N. Y. C. & H. R. R. R. stock,	100 00
Botanical department,	3,610 00
Horticultural department,	8,668 20
Farm,	15,933 20
Chemical laboratory,	1,986 00
Botanical laboratory,	2,056 53
Zoölogical laboratory,	1,894 75
Natural history collection,	5,278 85
Veterinary department,	1,615 66
Physics and mathematics,	4,513 00
Agricultural department,	3,267 58
Library,	18,050 00
Fire apparatus,	665 00
Furniture,	550 00
Books in treasurer's office,	241 16
Tools and lumber,	209 57
	$74,728 09

SUMMARY.

Assets.

Total value of real estate, per inventory,	$235,025 00
Total value of personal property, per inventory,	74,728 09
Bills receivable,	2,593 40
	$312,346 49

Liabilities.

Bills payable,	3,644 94
	$308,711 55

Maintenance Fund.

Technical educational fund, United States grant, ...	$219,000 00
Technical educational fund, State grant, .	141,575 35
	$360,575 35

Two-thirds of the income from these funds is paid to the treasurer of the college and one-third to the Institute of Technology. Amount received by the college treasurer from Jan. 1, 1897, to Jan. 1, 1898, ...	$11,791 97
Morrill fund, in accordance with act of Congress, approved Aug. 30, 1890. Amount received in 1897, ...	15,333 33
Hills fund, the gift of Messrs. L. M. and H. F. Hills of Amherst, now amounts to $8,542. By conditions of the gift the income is used for the maintenance of a botanic garden. Income from Jan. 1, 1897, to Jan. 1, 1898, ...	356 16
Annual State appropriation, $10,000. This sum was appropriated for four years by the Legislature of 1889, continued for another four years by the Legislature of 1892, and again by the Legislature of 1896, for the endowment of additional chairs of instruction and for general expense. Five thousand dollars of this sum was set apart as a labor fund, to be used in payment of labor performed by needy and worthy students. Amount received from annual State appropriation for college expense from Jan. 1, 1897, to Jan. 1, 1898, ...	5,000 00
Amount received as labor fund, ...	5,000 00

Scholarship Funds.

State scholarship fund, $10,000. This sum was appropriated by the Legislature of 1896, and is paid to the college treasurer in quarterly payments. Amount received from Jan 1, 1897, to Jan. 1, 1898, ...	10,000 00
Whiting Street fund, $1,000. This fund is a bequest without conditions. To it was added, by vote of the trustees, in January, 1887, interest accrued on the bequest, $260. Amount of the fund Jan. 1, 1897, $1,260. Income from Jan. 1, 1897, to Jan. 1, 1898, ...	51 05
Gassett scholarship fund, $1,000. This sum was given as a scholarship by Hon. Henry Gassett. Income from Jan. 1, 1897, to Jan. 1, 1898, ...	42 50
Mary Robinson fund, $858. This fund was given without conditions. The income from it has been appropriated for scholarships to needy and worthy students. Income from Jan. 1, 1897, to Jan. 1, 1898, ...	35 84
Amount carried forward, ...	$47,610 85

Amount brought forward, ...	$47,610 85

PRIZE FUNDS.

Grinnell prize fund, $1,000. This fund is the gift of Ex-Gov. William Claflin, and is called Grinnell fund in honor of his friend, George B. Grinnell, Esq. The income from it is appropriated for two prizes to be given to the two members of the graduating class who pass the best examination in agriculture. Income from Jan. 1, 1897, to Jan. 1, 1898, ...	40 00

MISCELLANEOUS FUNDS.

Library fund for the benefit of the library. Amount of fund, Jan. 1, 1898, $10,046.12.	
Burnham emergency fund, $5,000. This fund is a bequest of Mr. T. O. H. P. Burnham, late of Boston, and was made without conditions. The trustees have voted that this fund be kept intact, and that the income from it be used by the trustees for such purposes as they believe to be for the best interests of the college. Income from Jan. 1, 1897, to Jan. 1, 1898, ...	129 04
Income from Jan. 1, 1897, to Jan 1, 1898, ...	$47,779 89

To this sum should be added amount of tuition and room rent and receipts from sales from farm and from botanic gardens. These amounts can be learned from treasurer's statement, tuition and room rent being included in term bill account.

REPORT OF THE PRESIDENT OF THE MASSACHUSETTS AGRICULTURAL COLLEGE TO THE SECRETARY OF AGRICULTURE AND THE SECRETARY OF THE INTERIOR, AS REQUIRED BY ACT OF CONGRESS OF AUG. 30, 1890, IN AID OF COLLEGES OF AGRICULTURE AND THE MECHANIC ARTS.

I. Condition and Progress of the Institution, Year ended June 30, 1897.

The college has begun to recover from the effects of the hard times experienced during the past two years, and it is evident, from the improved tone and numbers in the entering classes, that the tide has passed its ebb and begun to flow back. In the regular course descriptive geometry has been dropped, and practical work in laboratory physics substituted. In the elective studies, courses in geology and modern history are offered. The dairy and short winter courses were opened for the first time this year, seventeen availing themselves of their advantages. The twenty acres purchased by the State and added to the college domain have been utilized by the horticultural department, and the ground broken up and prepared for orchards and nurseries.

This year closes the thirtieth of the existence of the college. Excluding those at present pursuing their studies, 1,093 have been admitted to its benefits. Of these, 1,001 are living, distributed as follows: 503 in agriculture and the mechanic arts, 498 in business and the various professions in life.

II. Receipts for and during the Year ended June 30, 1897.

1. Balance on hand July 1, 1896,	$578 96
2. State aid: (*a*) Income from endowment,	3,820 23
(*b*) Appropriations for building or other special purposes,	12,000 00
(*c*) Appropriation for current expenses,	15,000 00
3. Federal aid: (*a*) Income from land grant, act of July 2, 1862,	7,300 00
(*b*) For experiment stations, act of March 2, 1887,	15,000 00
(*c*) Additional endowment, act of Aug. 30, 1890,	14,666 66
4. Fees and all other sources,	3,000 00
Total receipts,	$71,365 85

Expenditures for and during the Year ended June 30, 1897.

Instruction in the subjects specified in section 1, act of Aug. 30, 1890,	$23,000 00
Instruction in all other subjects, if any, not mentioned in Question 1 of this series,	1,000 00
Administrative expenses (president's, secretary's, treasurer's, librarian's salary, clerical service, fuel, lights, etc.),	7,500 00
Experiment Station,	15,000 00
Total expenditures,	$46,500 00

IV. Property, Year ended June 30, 1897.

ue of buildings,	$189,275 00
ue of other equipment,	$73,872 78
ue of above property not used for instruction in the sub-cts specified in section 1 of act of Aug. 30, 1890,	$102,275 00
al number of acres,	404
es under cultivation,	260
es used for experiment,	60
ue of farm lands,	$45,000 00
ount of all endowment funds,	$360,575 35
nber of bound volumes in library,	18,080
nber of pamphlets,	–

V. Faculty during the Year ended June 30, 1897.

	Male.	Female.
College of Agriculture and Mechanic Arts, collegiate and special classes,	18	–
Number of staff of Experiment Station,	21	1
Total, counting none twice,	32	1

VI. Students during the Year ended June 30, 1897.

College of Agriculture and Mechanic Arts, collegiate and special classes,	129
Graduate courses,	4
Total, counting none twice,	132

FARM REPORT.

The farm operations of the past year have followed the general lines of the past few years. The work has been mainly confined to the cultivation and securing of our usual crops, and the caring for our rapidly increasing herd.

The peculiarities of the past season have rendered the results less satisfactory than usual. The four months, May, June, July and August, brought a total of about thirty-seven inches rainfall, about twenty-two inches coming in the months of June and July and nearly fifteen inches in the single month July.

This excessive rainfall largely increased the cost of caring for our field crops and securing the hay. It greatly decreased the yield of corn, ruined completely fields of carrots and mangels, caused a considerable portion of the potatoes upon about one-half our total area to rot, and decreased materially our crops of millet and soya beans. On the other hand, it gave us a large rowen crop, which serves in part to offset the losses in other directions.

The number of acres in the various crops of the year were as follows: hay, 78; corn for the silo and for fodder, 23½; field corn, 7; potatoes, 12; oats and pease, 1; soya beans, 3; Japanese barn-yard millet, 4½; beets, ½; carrots, 1; celery, 1¼; and turnips as a second crop, 1⅝.

The several fields and products were as follows: —

Hay. — Old fields (between college buildings and the county road, and including building site of old barn and farm-house), 42 acres: hay, 55 tons, 156 pounds; rowen, 36 tons, 1,289 pounds; total, 91 tons, 1,445 pounds, an average per acre of 2 tons, 368 pounds; fields where grass is grown in rotation, 36 acres: hay, 110 tons, 1,687 pounds; rowen, 34 tons, 1,800 pounds; total, 145 tons, 1,487 pounds, average per acre, 4 tons, 98 pounds. The total hay and rowen crops amount to 237 tons, 952 pounds, an average of a little over 3 tons per acre for the entire farm.

Corn for the Silo. — South flat, 15½ acres: 230 tons; north flat, 7 acres: 57 tons.

Field Corn. — South flat, 7 acres: grain, 281 bushels; stover, 9½ tons. Fodder put into the silo: 5 tons.

Potatoes.— Hatch slope, 6 acres: marketable tubers, 903 bushels; south flat, 6 acres: marketable tubers, 463 bushels.

Japanese Barn-Yard Millet. — North flat, 4½ acres: 29.7 tons.

Soya Beans. — North flat, 3 acres: 17⅝ tons.

Oats and Vetch. — North flat, 1 acre: 12½ tons.

Carrots. — One acre: failure on account of weather, and ploughed up.

Mangels. — One-half acre: failure on account of weather, and ploughed up.

Turnips as a Second Crop. — One and five-sixths acres: 405 bushels.

Celery. — North flat, 1¼ acres: crop estimated to be worth $400.

The system of manuring followed with the several crops is shown in the following table: —

Application per Acre.

	Old Mowings.	Field Corn.	Potatoes.	Onion Land, Potatoes.	Oats and Pease.	Japanese Millet.	Beets and Carrots.	Beans.	Celery.
Manure (cords),	-	5	-	-	4	1	-	3	16
Nitrate of soda (pounds),	150	100	240	120	250	175	200	-	450
Plain superphosphate (pounds),	-	200	400	400	400	150	300	250	550
South Carolina rock phosphate (pounds),	-	-	-	-	-	-	200	-	-
Dried blood (pounds),	-	-	100	50	-	-	-	-	250
Tankage (pounds),	-	-	240	120	-	-	150	-	400
Bone meal (pounds),	-	-	-	-	-	-	175	-	-
Muriate of potash (pounds),	-	140	-	-	300	100	250	-	350
High-grade sulphate of potash (pounds),	-	-	250	250	-	-	-	250	350
Armour's fertilizer (pounds),	-	-	-	-	-	-	-	-	2,000

Corn for the Silo. — Our principal field of ensilage corn was planted upon land most of which was tile-drained about six years ago. The soil was heavy, and the care of the crop was rendered very expensive on account of the frequent and heavy rains. The total area of this field is 15½ acres. The total labor cost (crop in the silo) was $342. One-half the manure and three-fourths of the fertilizer used are charged to the crop, at $190. The product,

230 tons, is valued at $805 in the silo, leaving the balance of $273 in favor of the crop. The average yield per acre was 15 tons. A small portion of this field which was not tile-drained furnished a most instructive object lesson. This portion of the field was not originally wetter than other portions. The crop, however, upon this part of the field was at the rate of only 4 tons per acre. The variety of corn cultivated in this field was the Leaming Field.

Field Corn. — The area devoted to this crop comprised 7 acres in the large field known as the south flat. The land had produced corn the previous year. This portion of the field is not tile-drained. It apparently needed this improvement much less than other parts of the field, but the past season has given us so much rain that the crop of corn this year was seriously injured. Upon a portion of the field it was so poor that it was cut and put into the silo, 5 tons of fodder being secured. The balance of the field gave us 281 bushels of grain, an average of about 40 bushels per acre, which is not much more than one-half our usual crop. The crop is to be charged with manure and fertilizer to the amount of $102, and labor $155.13, — a total cost of $257.13. The crop is worth about $200, leaving a balance of about $57 against the crop.

Potatoes. — Of the total area of 12 acres, one-half had a thoroughly drained medium loam and gave a fair crop. This portion of our potato land produced grass and clover in 1896. It is to be charged with fertilizer, $62.46 (three-fourths of the total used); seed, $42; Paris green, $2.56; labor, $201. The crop was dug before the vines were dead, and the work was done by hand. We obtained 903 bushels of marketable potatoes, which sold at 80 cents per bushel, amounting to $722.40, leaving a balance in favor of the crop of $414.38. The other 6 acres of potato land was upon soil which suffered from the excessive rainfall. One-half this land was in onions in 1896 and the balance in root crops. The fertilizer used is charged against the crop at $28.80; seed, $42; Paris green, $2.52; labor, $183.91; total, $257.23. A portion of the crop, as it was found to be rotting, was dug early by hand and disposed of at once; but the greater part of the field was left until the rotting had ceased, when it was dug by machine. That part of the field dug as soon as the rot was noticed gave a larger yield than the portion which was allowed to remain. The total yield of the 6 acres was only 463 bushels of sound, marketable tubers. These were sold for $372.40, leaving a balance in favor of the crop of $113.17.

Soya Beans. — These were grown on the north flat, occupying land that produced potatoes in 1896. The crop suffered seriously from the unfavorable season. The yield was only 17⅜ tons of green fodder, most of which was put into the silo. The crop is charged for manure and fertilizer, $66.35; for labor, $55.95; a total of $122.30, leaving a balance against the crop of $51.90.

Japanese Millet. — Four and one-half acres of the barn-yard variety of Japanese millet were grown upon the north flat. The crop is charged for manure and fertilizer, $24.45; for labor, $51.25; a total of $75.70. The crop was cut green and put into the silo, two parts of this millet to one of soya beans. The yield of millet was 297 tons, estimated to be worth in the silo $89.90, leaving a balance of $13.40 in favor of the crop.

Oats and Pease. — This crop occupied 1 acre on the north flat, and was grown at a cost for manure and fertilizers of $16.30 and labor $14.67; a total of $30.97. The yield was 12½ tons of fodder, which was fed green. This was estimated at $3 per ton, giving a total value of $37.50; leaving a balance of $6.53 in favor of the crop.

Celery. — This crop occupied 1¼ acres upon the north flat. The total cost of producing it and putting into the pit that portion not marketed from the field was $216. The crop is charged with manures and fertilizers, $71.75; labor, $144.25 (the last item including harvesting and preparing for market of the Dwarf Paris Golden variety, which was grown between the rows of the Pascal variety). The Dwarf Paris Golden was of fairly good quality, but sold at a low price, bringing in only $100. The Pascal celery was of remarkably fine quality, and is now about ready for market. It is estimated to be worth about $300, thus making the total probable returns from the field about $400.

Live Stock.

Horses. — Our horses and colts have all gone through the year in perfect health. We now own the following animals: Percherons, 1 stallion, 1 mare and 1 stallion colt; Percherons three-quarters blood, 2 mares; Percheron one-half blood, 1 mare; French Coach, 1 stallion colt, 1 mare colt; ordinary work horses, 1 stallion, 2 geldings, 2 mares; total, 13.

Neat Cattle. — Shorthorn, 1 male and 1 female; Ayrshire, 2 males, 2 females; Holstein-Friesian, 1 male, 2 females; Guernsey, 1 male, 2 females; Aberdeen-Angus, 1 female; grade Hereford, 1 female; Dakota cows and heifers, 39; grades (Jersey, Guern-

sey, Holstein-Friesian, Ayrshire and Shorthorn), 2-year-old, 7 females; 1-year-old, 18 females; grade (Jersey and Guernsey) cows, 17; grade Hereford, 1 heifer; total 101.

Southdown Sheep. — Thirty-one breeding ewes, 4 ewe lambs, 1 breeding buck, 1 yearling buck, 3 buck lambs; total, 40.

Swine. — Tamworth, 1 boar, 1 sow, 5 pigs; Chester White, 1 boar, 1 sow; Cheshire, 1 boar; Berkshire, 1 boar, 1 sow; Poland-China, 1 sow; Berkshire and Poland-China, cross-bred, 6 pigs, 2 fat hogs; Chester White and Cheshire, cross-bred, 2 fat hogs; common stock, 11 pigs; total, 34.

The general health of the cattle, sheep and swine has been good throughout the year and the breeding increase satisfactory.

Improvements.

The chief improvement of the year has been the moving and fitting up for a quarantine stable of the sheep shed formerly connected with the State Experiment Station barn. This shed is about twenty by forty feet, and has been moved to the foot of the Hatch slope and joined to the quarantine sheds which we already had there. It has been conveniently fitted up to accommodate fifteen cows.

The roads, bridges and drains of the farm have required an unusual amount of attention, on account of the excessively heavy rains. The roads have been badly washed and gullied, bridges have been washed out, streams have made for themselves new courses, and numerous breaks and washouts have occurred in the lines of drains. The repairing of damages of this description has involved much work and considerable expense.

No extensive land improvements have been made during the year.

Cash Receipts of the Year.

The total receipts for the year for products sold and labor performed amounted on December 10 to $5,775.06. The leading items were the following: milk and cream, $2,664.44; potatoes, $865.27; hay, $518.82; beef, $250.10; live stock, $227.75; labor, $191.73; and celery, $149.97. There is now due to the farm for products sold to date this year $902.18, making a total of receipts of $6,677.24.

In conclusion, I desire to testify to the continued faithful services of the farm superintendent, Mr. E. A. Jones. Amid circumstances in many respects difficult and in my absence during the

greater part of the year, he has devoted himself, with an eye single to its interests, to the management of the farm. In a season when on every hand farmers abandoned crops, leaving fields to grow to weeds, he has given all fields clean culture, and succeeded in most instances in securing fair crops where others failed.

WM. P. BROOKS,
Professor of Agriculture.

AMHERST, Dec. 24, 1897.

MILITARY DEPARTMENT.

AMHERST, MASS., Dec. 20, 1897.

To President H. H. GOODELL, *Massachusetts Agricultural College.*

SIR: — In compliance with instructions from your office, I have the honor to submit the annual report of the military department of the college for the year 1897.

The organization of the battalion last year was faulty in that the officers were more numerous than the number of privates warranted, with the result that there was little interest taken in the drill. At the commencement of the fall term the cadets were reorganized, with a cadet major, cadet adjutant, cadet sergeant major, cadet quartermaster sergeant, a drum and trumpet corps and two companies of thirty-five privates and non-commissioned officers each. The effects of this step are seen in the increased interest of the cadet officers and efficiency of the battalion.

Drills commenced on September 13, and have been held on Monday, Tuesday and Thursday of each week.

The seniors have received instruction in signalling with flag and heliograph, and, with one exception, are proficient.

The juniors and sophomores have been instructing the freshmen in squad drill, and the sophomores have received some instruction in target practice at one, two, three and four hundred yards.

Companies have been drilled by their company officers under my supervision, and a good knowledge of company drill has been obtained up to platoon movements. The battalion is well instructed in the new manual of arms, as modified by the War Department, for the Springfield rifle, and is also very efficient in the bayonet exercise.

The attendance at drill has been very good. The average of daily absentees for this fall term is 3.7, against 5 for the same time last year.

The drum corps is efficient and interested in its work, but the trumpet corps is not up to a proper standard, owing to lack of proper instruction. I recommend that a good drum and trumpet instructor be engaged to give instruction in the field music once a week during the winter term.

The dormitories are in better condition than last year. North lege has been provided with a bath-room and lavatories, which kes the building much more comfortable and convenient. I ommend that the painting of the bath-rooms and lavatories in ıth college be completed. This work was commenced about a ır ago, and has never been finished. The place needs painting y much, and should not be left half done.

It would be economy to give the drill hall a thorough painting the outside, and I renew my recommendations of last year ative to making the present armory a locker room where the dents can keep their athletic clothes and equipments. The gun d would be suitable for an armory and gun shed combined.

The college fire department has been reorganized and partially equipped, and is in efficient condition. The new water system the college gives excellent fire protection.

The new target pit and butt is entirely satisfactory, and affords ple protection to the cadets working there.

The following three members of the class of '97 were reported the Adjutant-General of the Army and the Adjutant-General the State of Massachusetts as having shown the greatest proency in the art and science of war: —

adet First Lieutenant and Adjutant, . .	G. D. LEAVENS.
adet First Lieutenant and Fire Marshal, .	H. J. ARMSTRONG
adet Second Lieutenant, ...	H. F. ALLEN.

he following is a list of the United States property now on d: —

Ordnance.

2 3.2-inch B. L. field guns.
2 8-inch mortars, with implements.
2 gun carriages
2 gun caissons with spare wheels.
2 mortar beds
47 Springfield cadet rifles.
47 sets in infantry accoutrements.
51 headless shell extractors.
50 metallic ball cartridges.
2 mortar platforms.
C0 pasters.
75 paper targets.
00 cartridge primers.
00 round balls.
1 set reloading tools.
75 pounds small arms powder
2 sets implements and equipments for 3.2-inch B. L. field guns.

Signal.

2 heliographs, complete.
6 2-foot white flags.
6 2-foot red flags.
6 canvas cases and straps.
12 joints of staff.

The following are the officers of the battalion: —

Commandant.

First Lieut. W. M. WRIGHT, ... Second U. S. Infantry.

Field and Staff.

Cadet Major, ... R. D. WARDEN.
Cadet Adjutant, ... W. S. FISHER.

Company A.

Cadet Captain, ... A. MONTGOMERY, Jr.
Cadet First Lieutenant, ... J. P. NICKERSON.
Cadet Second Lieutenant, ... C. G. CLARK.

Company B.

Cadet Captain, ... G. H. WRIGHT.
Cadet First Lieutenant, ... C. N. BAXTER.
Cadet Second Lieutenant, ... J. S. EATON.

Respectfully submitted,

WM. MASON WRIGHT,
First Lieutenant Second U. S. Infantry.

THE PTEROPHORIDÆ OF NORTH AMERICA.

C. H. FERNALD, A.M., PH.D.

Massachusetts Agricultural College.

January, 1898.

THE PTEROPHORIDÆ OF NORTH AMERICA.

The species of moths taken up in this work are known by the mmon names of plume-moths and feather-wings. They have en studied but very little, and our knowledge of the early stages d habits of a large proportion of our native American species is y imperfect, but it is hoped that our entomologists will give re attention to them hereafter.

GEOGRAPHICAL DISTRIBUTION.

The Pterophoridæ are distributed very widely over the globe, appear to be most numerous in the temperate regions, parılarly in Europe, North America and Australia; yet, when er parts of the globe have been as carefully explored, it is bable that many additional species will be discovered, and that y may be more evenly distributed than at present appears to be case.

GEOLOGICAL DISTRIBUTION.

I am indebted to Mr. S. H. Scudder, our highest authority on sil insects, for the information that no Pterophoridæ have yet n recognized among the fossils, not even in amber.

ECONOMIC IMPORTANCE.

A few species of the Pterophoridæ are injurious to plants of nomic importance, and the larvæ of several others feed on nts raised for ornamental purposes or for flowers.

NATURAL ENEMIES.

While it is probable that the species of this family are preyed on not only by insect enemies but also by birds, yet I have en able to find but few recorded observations with regard to m. Ashmead has described *Pimpla pterophori* and *Limneria rophoræ* from Pterophorids in California, and the latter species s also been taken in Texas. Prof. Kellicott bred *Ichneumon milis* Prov. from *Platyptilia carduidactyla*.

History.

Linnæus, in the tenth edition of his "Systema Naturæ," Vol. 1, page 542, published in 1758, established the genus *Alucita* for the plume-moths with the following six species under it in order: *monodactyla*, *didactyla*, *tridactyla*, *tetradactyla*, *pentadactyla* and *hexadactyla*, — all placed under the heading Alucitæ. Some of these insects had been figured and described more or less fully by authors previous to the time of Linnæus, as Aldrovandus, 1602; Madam Merian, 1679; Petiver, 1702; Ray, 1710; Frisch, 1721; Reaumur, 1736; and Rosel, 1746; but, as Linnæus in the above work first consistently used the binomial nomenclature, it has been decided almost universally by zoölogists to adopt this edition of the "Systema Naturæ" as the starting-point in zoölogical nomenclature.

In 1761, Poda published his "Insecta Musei Graecencis," in which, on page 94, he adopted the generic name *Alucita* with *pentadactyla* L. the only species under it, and this species is therefore regarded as the type of the genus *Alucita* by Lord Walsingham and other eminent authorities. Geoffroy, in 1762, published the first edition of his "Histoire abrégée des Insectes," in two volumes. In the second volume this author, rejecting the genus *Alucita* of Linnæus, established the genus *Pterophorus*, a name which he stated was given to these insects by some naturalist in former times, and placed under it *pentadactyla* L. *didactyla* L. and *hexadactyla* L. From his description of *didactyla*, there can be no doubt that, instead of this species, he had *monodactyla* L. before him, and therefore we must consider *didactyla* Geoff. the same as *monodactyla* L. As Poda had already used *pentadactyla* as the type of *Alucita*, only the species *monodactyla* L. and *hexadactyla* L. could be considered as belonging under *Pterophorus*.

Scopoli, in his "Entomologia Carniolica," published in 1762, gives five species of plume-moths under Phalæna, which he appears to have used in a generic sense. In 1775, Fabricius, in his "Systema Entomologiæ," page 667, very improperly made use of the genus *Alucita* for *xylostella* L. and nineteen other Tineids, and followed Geoffroy in using *Pterophorus* for the plume-moths. This use of these generic names he continued through all his writings. The authors of the "Systematische Verzeichniss der Schmetterlinge der Wienergegend," 1776, page 144, adopted the genus *Alucita* in the strict Linnæan sense.

Latreille, in his "Precis des Caracteres generique des Insectes," published in 1796, page 148, separated *hexadactyla* from the group

and established for it the genus *Orneodes*, but retained the rest of the plume-moths under Pterophorus. Latreille repeated this use of these generic names in his "Histoire naturelle des Crustaces et Insectes," Vol. XIV., page 255 (1805), and used the generic name *Alucita* in the Fabrician sense. This action of Latreille in removing *hexadactylus* from *Pterophorus* left only the species *monodactylus* L. under it which must now be regarded as the type, while *Orneodes* must be recognized with *hexadactyla* L. as the type.

In 1806 Hübner published his "Tentamen," in which these insects are placed in Phalanx 9; Alucitæ, in Tribus 1: *indubitate.* There are two divisions under this, the first of which is Pterophoræ with *Pterophora pentadactyla*, and the second is Ripidophoræ with *Ripidophora hexadactyla.* The "Tentamen" has caused a great deal of controversy as to whether it was a true publication, and whether its generic names should be recognized. No question can arise in case of the plume-moths, as Poda had long before adopted *pentadactyla* as the type of *Alucita*, and Latreille had very properly separated *hexadactyla* from the group and established for it the genus *Orneodes.* Schrank, in the second part of Vol. II. of his "Fauna Boica" (1802), page 139, adopted the Linnæan genus *Alucita* for these insects.

In 1811 Haworth published the third part of his "Lepidoptera Britannica," in which he adopted the genus *Alucita* in the Linnæan sense for the plume-moths. In 1815, Leach published his article "Entomology" in the "Edinburgh Encyclopædia," in which, under Tribe VII, Alucitides, the genus *Pterophorus* Geoff. is adopted with *pentadactylus* and *didactylus* under it, and the genus *Alucita* with *hexadactyla* under it. In 1819 Samoulle published his "Entomologist's Useful Compendium," in which he adopted the classification of Leach.

Hübner, in his "Verzeichniss bekannter Schmetterlinge," adopted the term Alucitæ for his ninth phalanx, the plume-moths. This part of the "Verzeichniss" was published between Aug. 27, 1825, and the time of Hübner's death, which occurred Sept. 13, 1826. This author divided these insects into three tribes: the first including those with unfissured wings, for which he established the genus *Agdistis;* the second with those having one fissure in the fore wings and two in the hind wings. This tribe was further divided into two families, each containing two genera. The first family, Obtusæ, contained the genera *Platyptilia* and *Amblyptilia*, and the second family, Cuspides, contained the genera *Stenoptilia* and *Aciptilia.* The third tribe included those species in which each wing is divided into six parts, and these were all

placed under the genus *Euchiradia*, which is of course synonymous with *Orneodes*.

In 1827 Curtis published Vol. IV. of his "British Entomology," in which he adopted the genus *Pterophorus* and names *pentadactyla* L. as the type. In Vol. X. of the same work (1833), he established the genus *Adactylus* with *adactyla* Hüb. for the type. In Vol. XV., published in 1838, he adopted the genus *Alucita* and named *hexadactyla* as the type. Curtis, in 1829, in his "Guide to an arrangement of the British insects," had taken the genus *Adactylus* for the species with undivided wings, *Alucita* for "*hexadactyla* and its allies" and *Pterophorus* for the remainder. In the same year Stephens published his "Catalogue of British insects," in which he adopted the genus *Agdistis* Hüb. for the species with undivided wings, and *Pterophorus* and *Alucita* in the same sense as Curtis had used them. This same classification was used by Stephens in 1834, in his "Illustrations of British Entomology."

Treitschke, in Vol. IX., Part 2, of his "Schmetterlinge von Europa," published in 1833, adopted the generic name *Alucita* for the species placed by Stephens under *Agdistis* and *Pterophorus*, while he used *Orneodes* for *hexadactylus* and its allies. In 1836, Duponchel, in his "Histoire naturelle des Lepidopteres," Vol. IX., adopted the classification of Latreille, but in his "Catalogue Methodique," published in 1844, he used the genus *Adactyla* Zell. for *hübneri* Curt., *Orneodes*, for *hexadactyla* and its allies, and *Pterophorus* for the remaining species. Westwood, in Vol. I. of his "Classification of insects," page 115, published in 1839, adopted the classification of Stephens.

Zeller, in 1841, published his monograph of the plume-moths in "Isis," Vol. X. This author adopted the name *Pterophoridæ* for the group, and divided them into the *Pterophoridæ proprii*, and *Alucitina*. Under the first division he established the genus *Adactyla*, apparently unconscious of the fact that Curtis had already used the same name. Under this same division Zeller adopted the genus *Pterophorus* Geoff., which he divided into groups or subgenera as follows: *Platyptilus* (*Platyptilia* Hüb.), *Oxyptilus* (*Amblyptilia* Hüb.), *Pterophorus* (*Stenoptilia* Hüb.), *Aciptilus* (*Aciptilia* Hüb.). The division *Alucitina* contained the genus *Alucita* with *hexadactyla* and allies under it. In 1852, Zeller published his "Revision of the Pterophoridæ" in "Linnæa Entomologia," Vol. VI., page 319, in which he sinks his genus *Adactyla* and adopts Hübner's *Agdistis*, and established the genus *Deuterocopus* for the species *tengstrœmi* of Java.

In 1840, Zetterstedt, in his "Insecta Laponica," placed all his plume-moths under the genus *Alucita*, but in a note refers to *Orneodes hexadactyla* indicating his adoption of this generic name. Herrich-Schæffer, in his "Schmetterlinge von Europa," Vol. V., published in 1853–55, follows the classification of Zeller. Stainton, in his "Manual of British Butterflies and Moths" (1859), adopted the generic name *Adactyla* for *bennetii*, *Pterophorus* for *rhododactylus* and its allies and *Alucita* for *polydactyla*.

In 1859, Wallengren published his work on the Scandinavian plume-moths, which, like Zeller's works, marked an era in the classification of these insects. Wallengren followed Zeller in dividing them into the *Pterophoridæ* and *Alucitina*, under the first of which he established four new genera, and used, in addition to these, five genera established by earlier authors. Under *Alucitina* he adopted the genus *Alucita* for *hexadactyla*.

In 1864, Walker published Part 30 of his "List of the Lepidopterous Insects in the British Museum," in which he refers to all the described species of the plume-moths, and added thirty-five new species and two new genera founded on new species from Ega, South America. In this work Walker followed the classification of Zeller.

In 1869, Dr. Jordan, in the "Entomologist's Monthly Magazine," Vol. VI., pages 119 and 149, gave a review of Wallengren's work, referred to above, which contains valuable information. Mr. South has given a most interesting and valuable series of illustrated papers on the early stages, habits and food plants of the British plume-moths in the "Entomologist," Vol. XIV. and following volumes. Tutt's "Monograph of the Pterophorina of Britain" is also a valuable paper on the British plume-moths. In 1877, Dr. Wocke, in "Die Schmetterlinge Deutschlands und der Schweiz," Vol. II., Part 2, followed very closely the classification of Wallengren. In 1886, Leech, in his "British Pyralides," including the Pterophoridæ published in 1886, uses the super family Pterophori with the families *Pterophoridæ* and *Alucitidæ* under it.

Meyrick, in his paper "On the Classification of the Pyralidina of the European Fauna," published in 1890, in the "Transactions of the Entomological Society of London," placed these insects as families under the super family Pyralidina. Mr. Meyrick had already made critical studies on these insects in his researches on the Lepidoptera of Australia and New Zealand and in the paper above referred to he gave most excellent characters to the families and genera. He adopted the family names *Pterophoridæ* and *Orneodidæ* with the genus *Orneodes* under the last for *hexadactyla*

and its allies. In his "Handbook of British Lepidoptera" (1895), Meyrick retains substantially the same classification. The latest and one of the most valuable works that I have seen is "Die deutschen Pterophoriden" by Dr. O. Hofmann (1895). In this work we are given for the first time a very good account of the genitalia, and all stages are described in full so far as known.

The first writer on the North American plume-moths, so far as I am able to learn, was Fitch, in his first "Report on the Insects of New York," page 145 (1856), where he published eight species, placing them under the genus *Pterophorus*. In 1864, Walker published two species from this country under the same genus, in the "Catalogue of the Lepidoptera Heterocera," Part 30, page 940. In 1869, Riley, in his first "Report on the Insects of Missouri," published one new species and gave a more complete description of one of the species of Fitch. In 1873, Packard described three species from California under the genus *Pterophorus*, in the "Annals of the Lyceum of Natural History," Vol. X., page 265. In the same year Zeller, in his "Beitrage," described six new species of the North American plume-moths, and in the same paper established a new genus (*Scoptonoma*) with two new species from Texas. This genus, however, proved to be the same as *Lineodes* of Guenee, a Pyralid genus. The next year Zeller described his *Leioptilus Mathewianus* in his "Lepidoptera der Westkuste Amerika's," page 23. Chambers published *Pterophorus lacteodactylus* in the "Canadian Entomologist," Vol. V., page 265 (1873).

The most important contribution to our knowledge of the North American species of these insects was given by Lord Walsingham in his "Pterophoridæ of California and Oregon," published in 1880. This work contains full descriptions of forty-one species. many of them here published for the first time, and all of the species are illustrated in colors. Lord Walsingham was so generous as to give me co-types of nearly all of his species. In this same year Miss Murtfeldt described two new species with their early stages in the "American Entomologist," Vol. III., page 235. In 1881, Mr. Charles Fish described ten species of these moths in the "Canadian Entomologist," Vol. XIII., pages 70 and 140. This gentleman made extensive studies of the Pterophoridæ, and secured the types of Fitch's species and all of his notes on them; but, having abandoned the work because of other engagements, I obtained his entire collection of these insects, including all of his own types as well as those of Fitch. Valuable notes by other

writers have also been made, which will be referred to under the various species on following pages.

Structure.

The Pterophoridæ are small, slim insects, with long, slender legs and long, narrow fore wings, cut by a fissure extending in from the middle of the outer margin between veins 4 and 7, from a fourth to one-half of the length of the wing (plates II. and III.). The parts on each side of the fissure are called lobes, the anterior one being called the first lobe and the other the second lobe. In some of the genera these lobes are narrow and pointed, while in others they are well developed and present two well-marked angles on each, which are called the apex and anal angle (Plate II., fig. 1). The normal number of veins in the fore wings is twelve, but this number is reduced in many of the species. Vein 1 is feebly forked at the base, at least in some of the species, and the cross vein and veins 5 and 6 are very weak, often entirely invisible; 5 and 6 at equal distances from each other and from 4 and 7, extending to the fissure which ends between them. Veins 8 and 9 are stalked and 10 sometimes arises from the same stalk, but is occasionally wanting.

The hind wings have two fissures, the first extending in from the outer margin between veins 4 and 7 to about the middle of the wing; the second, between the inner margin veins and vein 2, extends to about the basal fourth. These divisions are called feathers, the anterior one being called the first feather, the middle one the second feather and the posterior one the third feather (Plate II., fig. 2).

The first feather in some species is somewhat spoon-shaped, rounded at the outer end, widest near the middle and narrower near the base. The costal vein bends down near the middle of its course, approaching very near to the subcostal. The costal vein ends in the costa when this feather tapers gradually to a point and vein 7 ends in the point. When this feather is broad at the outer end and has two angles corresponding to the apex and anal angle, the costal vein usually ends in the apex and vein 7 in the anal angle. The frenulum is single in the male and divided in the female.

The second feather in some species is widest towards the outer end, which is very oblique, but in others it is of the same form as the third feather. The median vein runs into this feather, giving off vein 2 which ends in the hind margin, vein 3 which ends in the anal angle of this feather and vein 4 which ends in the apex. In

the narrow, tapering forms vein 4 is wanting and 3 runs to the end of the feather. The cross vein and also veins 5 and 6 are exceedingly fine and scarcely visible under the most favorable circumstances.

The third feather tapers gradually to the more or less blunt outer end, but in some species it has a very obtuse and rounded angle on its hind margin, which represents the anal angle of the wing (Plate II., fig. 2). This feather has a strong vein running through the middle to the end, which is undoubtedly vein 1b. In some species a weak vein may be seen above lying very near the edge of the feather, and in others a shorter vein below running to the hind margin of the feather a little beyond the anal angle. This, without doubt, is vein 1a, and therefore the three internal veins are represented in the Pterophoridæ, but all three do not occur in any one species.

The fringes are long and arranged along both sides of the feathers, giving them a strong resemblance to the feathers of a bird, thus making more complete organs of flight. In some species there are clusters of dark spatulate scales in the hind fringe of the third feather, and similar scales occur along the median vein on the under side of the wing. The basal part of the median vein on the upper side of the hind wings is not provided with a row of fine hairs, as in some families of moths.

The head is of medium size, with the front smooth and vertical in some species but more or less conical in others. The labial palpi are either porrect or curved upward and closely scaled, or more or less bushy. The maxillary palpi are entirely wanting. The proboscis is about as long as the head and thorax, and not clothed with scales at the base. The eyes are nearly hemispherical, naked and without lashes or cilia. The ocelli are absent. The scales of the head lie smooth over the surface, giving it an even appearance; but in some species they form a more or less cone-shaped tuft, extending forward from the front. The antennæ are fine filiform, and about two-thirds as long as the costa of the fore wings. The basal segment is much larger than those beyond, and covered with scales which sometimes form a pointed tuft at the end. The remaining segments are finely ciliated, those in the males being stronger than in the females.

The thorax is of medium size, and its covering of scales smooth without any indication of tufts or other characters. The tegulæ are of medium length, without long scales, hairs or other unusual characters. The abdomen is long and slim, of nearly uniform size throughout in the male, but somewhat fusiform in the female.

he genitalia of the male consist of a pair of long, comparatively in and broad exserted claspers and a prominent uncus.

The legs are long and slim with cylindrical segments, except the mora, which are somewhat compressed. The coxæ are about as ng as the thorax and stouter than the remaining segments of the gs. The fore tibiæ have a tibial epiphysis on the inside near the d, the middle tibiæ have a pair of unequal spurs at the end, ile the hind tibiæ have a pair of unequal spurs at the end and a nilar pair at the outer third. The tarsi consist of five segments th a pair of claws at the end. There are no spines on any of segments of the legs, but they are covered by scales that lie ooth and close to the surface. In some species, however, the les are raised, forming an enlarged ring around the middle and d legs at the base of the spurs, and a similar ring occurs around end of the fore tibiæ. In one species (*monodactylus*) there is mall tuft of scales on the hind tibiæ, opposite and within the ddle spurs (Plate I., figs. 11, 12). This character is very use- in determining this exceedingly variable and common species.

The ground color of the Pterophoridæ is generally white, yellow- white or some shade of brown, occasionally without darker rkings, though the fore wings most frequently have a dark tri- gular spot resting on the costa and extending down to a point t within the end of the fissure. One or two light lines cross the es obliquely, and there is a dark spot on the cell a little before middle of the wing and another on the fold still nearer the base the wing. The hind wings are of one uniform color, and seldom re spots or lines of other colors.

Habits.

The usual time of flight is on warm, calm evenings, when they occasionally attracted to light and rarely to sugar. They may, vever, be easily "flushed" in the day time from the shrubbery, en they fly a short distance and alight. When at rest they hold ir wings nearly horizontal and at right angles with the body, the feathers of the hind wings are folded over each other and wn under the fore wings.

Early Stages.

I am not aware that anything is known of the egg-stage of any our North American plume-moths, and if any thing has been blished on this stage, I have overlooked it. In the European cies, so far as I have seen any descriptions, they are more or s oval in outline, smooth and of a pale-green color.

The larvæ are short and stout, pale green, with longitudinal stripes of other colors in some species, and one or more coarse or fine hairs arise from tubercles on the segments. The pupæ are formed above ground, and attached by the anal extremity. Some species are hairy, while others are naked; and they sometimes have a pair of prominent tubercles arising from the back.

It is not known positively whether any of our North American species have more than one generation in a season; but so little is known about them that we cannot speak with any certainty on this point. *Acanthodactyla* and *monodactyla* are said to have two generations in a year in Europe, and very likely this is true here, at least in some parts of the country.

Systematic Position.

Linnæus placed these insects at the end of the Lepidoptera after the Tineina, and he was followed by later writers till a little more than twenty-five years ago, when it began to dawn upon those who were working upon these insects that they were out of place. At first the matter was talked over, but it was some time before any one seemed to be willing to express such an apparent heterodox opinion in print. Dr. Jordan, however, in 1869 (Ent. Mon. Mag., Vol. VI., p. 152), expressed the opinion that these insects form "an aberrant group of the Pyralidæ." A few years ago, entomologists, both in this country and England, in making critical studies on the early stages as well as on the imago of the Lepidoptera, quite revolutionized the order, not only with regard to the position of the families, but also with regard to the names. I am heartily in sympathy with this movement, and, if I do not always adopt the changes at once, it is because I have not had time to study them carefully and convince myself that they are right.

The genus *Chrysocorys* has been placed among the Pterophoridæ by several of the English entomologists, and Zeller established the genus *Scoptonoma* for two Texan species, placing it in this family; but this genus is identical with *Lineodes* Guen., which both he and Lederer very properly placed among the Pyralids. If these two genera be removed, we have rather a compact group, which may be placed in the vicinity of the Pyralids, in my opinion.

Characters of the Pterophoridæ.

Long, slim insects, with long legs. Fore wings usually with one fissure and hind wings with two. The North American species, so far as known, have fissured wings. Proboscis and labial palpi well developed. Maxillary palpi and ocelli absent.

'ore wings with vein 1 b either simple or with a short fork at the ase; 1 c present, 4 and 5 remote at the base, 8 and 9 stalked or ısed. Hind wings above without a row of hairs along the basal art of the median vein; 1 a usually absent, 4 and 5 remote at the ase, 6 and 7 remote, 7 and 8 approach very near each other near ıe middle of the wing.

SYNOPSIS OF THE GENERA.

Hind wings with a cluster of black scales in the fringe of the third feather,	2.
Hind wings without a cluster of black scales in the fringe of the third feather,	4.
Anal angle present in second lobe of fore wings,	3.
Anal angle absent in second lobe of fore wings,	*Trichoptilus.*
Anal angle absent in first lobe of fore wings,	*Oxyptilus.*
Anal angle present in first lobe of fore wings,	*Platyptilia.*
Feathers of hind wings similar and tapering uniformly,	*Alucita.*
Feathers of hind wings unlike in form,	5.
Anal angle present on first lobe of fore wings,	*Stenoptilia.*
Anal angle absent on first lobe of fore wings,	*Pterophorus.*

GENUS TRICHOPTILUS Wlsm., Pter. Cal. and Ore. (1880).

Front neither extended nor tufted, vertex smooth. Antennæ ıbescent; palpi slightly ascending; second and third segments arly equal in length, the former a little thickened with scales, pecially towards the outer end, the latter filiform. Tibiæ ickened with scales at the origin of the spurs. Fissure of the re wings extending in a little more than half their length, the bes being very slender, diverging, and without the anal angle on her. Hind wings with the fissure between the first and second athers reaching within one-fourth of their base, while the second sure reaches nearly to the base of the wing. All the feathers e very slender, almost filiform, and there is a cluster of black ales in the fringe near the middle of the hind margin of the ird feather.

This genus was established by Lord Walsingham on a single ecies, *pygmæus*, of which his lordship took three specimens near ilville, in Shasta County, California, on the 11th of July, 1871, e of which with his characteristic generosity he gave me. As is single co-type is all I have, I do not feel like injuring it to ıdy the venation or genitalia. Mr. Meyrick, in his "Hand-ok of British Lepidoptera," has given the venation of the fore ngs probably of *T. paludum* Z. as follows: 2 out of 4 or absent, absent, 7 and 9 absent, 10 from near 8 or absent, 11 from near 8.

Hofmann gives a description of the male genitalia and a figure of a paramere of *T. paludum*. He states that the genitalia of the male are distinguished by the remarkable form of the claspers, which are long and narrow, hollow within, and with a broad, bell-shaped, bristly appendage. The tenth dorsal plate is obtusely triangular, arched and bent down at the end. The ninth dorsal and ventral plates offer nothing especially worthy of remark.

Synopsis of the Species.

Expanse of wings, 10 mm. or less, . . .	*pygmæus.*
Expanse of wings, 17 mm., ...	*ochrodactylus.*
Expanse of wings, 20 mm., ...	*lobidactylus.*

Trichoptilus pygmæus.

Trichoptilus pygmæus Wlsm., Pter. Cal. and Ore., p. 64, Plate 3, fig. 15 (1880).

Expanse of wings, 10 mm. Head and thorax pale fawn color; antennæ slightly pubescent, marked above with fawn brown and white alternately; palpi whitish touched with fawn color. Abdomen whitish, with a tinge of fawn color on the sides and above posteriorly. Legs white, dotted and barred above with fawn brown; spurs white, and at their origin the legs are thickened with fawn brown scales, among which project some which are white and almost erect. Fore wings very pale fawn color, dusted with fuscous brown scales along the costa, especially above the base of the fissure and near the base of the hind margin. Two indistinct white stripes cross the lobes of the fore wings, one beyond and the other before the middle, cutting the fawn-colored fringes on each side. Hind wings pale grayish brown, with cinereous fringes interrupted with white behind and at the apex. The third feather has long cinereous fringes interrupted with white at the apex, and there is a cluster of dark scales slightly beyond the middle in the fringe of the hind margin.

Habitat. — Shasta County, California. Early stages and food plant unknown.

Trichoptilus ochrodactylus.

Trichoptilus ochrodactylus Fish, Can. Ent., Vol. XIII., p. 142 (1881).

Expanse of wings, 17 mm. Head and anterior part of the thorax pale ochreous. Antennæ with a longitudinal brown line above, bordered by a fine white line on each side, pale ochreous beneath. Posterior part of thorax and abdomen light cream color, the latter nearly pure white beneath. Legs white, striped long-

udinally with pale brownish ochreous; posterior tibiæ with a and of raised ochreous scales before each pair of spurs. Fore ings pale ochreous, approaching to cream color, with a very light rownish tinge on the first lobe. A minute brown spot at the ase of the first lobe reaches from the end of the fissure half way the costa. Costal fringe of the first lobe brownish ochreous, ith a longitudinal white spot at the basal third, another at the ıter third and a smaller one just before the apex. Fringe of the ssure ochreous and tinged with brown just beyond the middle, ıd there are some white hairs near the apices. Fringe of hind argin pale ochreous, with a white patch near the middle of the cond lobe, beyond which the fringe is rather dark brownish, th a streaklet of white near the apex. Hind wings pale brown, th the fringes slightly paler. The third feather has a cluster of rk-brown scales in the hind fringe, just beyond the middle, and row of club-shaped white scales extends from this to the base of e wing.

Habitat. — Texas. Early stages and food plant unknown.

TRICHOPTILUS LOBIDACTYLUS.

Pterophorus lobidactylus Fitch, N. Y. Rep., Vol. I., p. 848 (1854).
Aciptilus californicus Wlsm., Pter. Cal. and Ore., p. 60, Pl. II., fig. 9 (1880).

Expanse of wings, 17-20 mm. Head grayish brown, with a ile line over each eye; palpi whitish, touched with brown on the tside of the second segment, with a long, slim tuft at the outer d beneath, of nearly the same size and length as the slim outer gment, which is dark brown, as is also the tuft at the end of the ond segment. Antennæ grayish beneath, blackish above and tted with white. Thorax brown, much lighter posteriorly. domen dark brown, with diverging white lines on some of the gments. Legs striped with dark brown and white, with a tuft dark scales at each pair of spurs; tarsal segments white at the se and brown at the outer end.

Fore wings with the fissure extending in one-half of the length the wing, dark cinnamon brown. An oblique stripe of pale low or white crosses the basal third of the first lobe, cutting the own fringe on each side of the lobe. Traces of this stripe are netimes seen on the second lobe, especially in the fringe on the d margin. There are also indications of a second stripe on outer third of the lobes, as shown by a few light scales and white in the fringes, which are dark elsewhere except on the

apical end of the costa. Hind wings and fringes dark brown, with a cluster of black scales in the hind fringe a little beyond the middle, preceded by white, and the fringe at the apex is also white.

I have carefully compared four examples of *californicus*, given me by Lord Walsingham, with seven eastern examples of *lobidactylus* Fitch, and can see no difference except in the ground color, which is considerably lighter in the former; but, as the genitalia are absolutely alike in both, I must consider *californicus* only as a variety. Lord Walsingham doubtfully referred this species to the genus *Aciptilus*, but it seems to me to agree better with the characters of *Trichoptilus*.

Habitat. — Massachusetts, Connecticut, New York, Colorado, California. Food, *Solidago canadensis*.

I have been informed by Mr. Fish that Mr. N. Coleman of Berlin, Conn., has bred this insect from this plant.

Genus OXYPTILUS Zeller, Isis, Vol. X., p. 765 (1841).

Front smooth, without projection; labial palpi longer than the head, ascending, the second segment with appressed or projecting scales beneath, sometimes forming a short tuft at the apex, terminal segment filiform. Legs long and slim, the anterior and middle tibiæ thickened with scales at the middle and end. Fore wings fissured nearly to the middle, the first lobe narrow, curved somewhat at the end and terminating in a point without a defined anal angle. Second lobe with the apex somewhat produced, and with a more or less prominent anal angle. Feathers of the hind wing narrow and pointed, linear and without anal angles. Vein 2 arises from the median vein, a little before the outer end of the cell, while 3 and 4 arise from a short stalk, 9 and 10 arise one after the other from 8, and 11 arises near 8 from the upper angle of the cell. In the hind wing the costal vein terminates near the outer third of the costa; the continuation of the subcostal runs through the middle of the first feather and ends in the apex. The median vein has three branches the third of which ends in the apex of the second feather. The third feather with a single strong vein through the middle, terminating in the apex. This feather has a cluster of dark scales in the hind fringe beyond the middle. The characters of the male genitalia are represented in Plate VI., figs. 1–8.

SYNOPSIS OF THE SPECIES.

General color tawny yellow, ...	*periscelidactylus.*
General color light reddish brown, . .	*delawaricus.*
General color dull grayish brown, . . .	*ningoris.*
General color dark brown, ...	*tenuidactylus.*

OXYPTILUS PERISCELIDACTYLUS.

Pterophorus periscelidactylus Fitch, N. Y. Rep., Vol. I., p. 843 (1854).
Pterophorus periscelidactylus Riley, Mo. Rep., Vol. I., p. 137 (1869).
Pterophorus periscelidactylus Riley, Am. Ent., Vol. II., p. 234 (1870).
Oxyptilus periscelidactylus Zell., Ent. Zeit., Vol. XXXII., p. 178 (1871).
Pterophorus periscelidactylus Pack., Guide, p. 356 (1872).
Oxyptilus periscelidactylus Zell., Beitr., Part 2, p. 119 (1873).
Pterophorus periscelidactylus Saund., Can. Ent., Vol. V., p. 99 (1873).
Oxyptilus periscelidactylus Wlsm., Pter. Cal. and Ore, p. 25, Pl. II., fig. 5 (1880).
Oxyptilus periscelidactylus Saund., Ins. Inj. Veg., p. 268 (1889).
Oxyptilus periscelidactylus Comst., Manual, p. 238 (1895).
Oxyptilus periscelidactylus Smith, Econ. Ent., p. 318 (1896).

Expanse of wings, 14 to 29 mm. Head, thorax and fore wings ny yellow. Palpi slim, porrect or ascending, reaching as high he top of the head, white touched on the outside of second and d segments with tawny yellow. Antennæ dark brown beneath, te above and dotted with white along each side. Posterior t of the thorax marked in some specimens with white on the of the tegulæ, the sides and two longitudinal stripes on the top he metathorax. Abdomen tawny yellow, marked more or less erfectly with a white stripe along each side and also on each of the dorsal stripe, except on the third segment, which is rely dark tawny brown. Underside white, striped with tawny wn. Fore legs white, with longitudinal brown lines on the ora and tibiæ; middle and hind femora white, striped with ny; middle tibiæ tawny on the outside, also a tuft of scales the middle and at the end tawny; hind tarsi tawny at the mid- and end, and all the tarsi are marked more or less with this r at the end of the segments.

ore wings fissured nearly to the middle, tawny yellow, with oblique white stripes crossing the lobes, dividing them into rly equal parts, the space between these stripes often rusty wn, a transverse white spot just within the end of the fissure dged on its inner side with rusty brown, the posterior end often ending outward and fusing with the first cross line. There is ally a very oblique white spot on the cell near the middle of

the wing, with a dark dot at the basal end of it, and a second white spot rests on the hind margin at the basal fourth of the wing. The fringes of the two lobes are whitish, cut by blackish at the apex and anal angle, this latter on the second lobe extending along nearly half the hind border. Hind wings rusty brown, the third feather white in the middle and dark brown at the end, with large dark scales in the fringes on both sides of this part of the feather.

Thirty-five specimens examined.

Habitat. — Maine to Missouri, Ontario, Quebec, Texas. Food, leaves of the grape vine.

Larva. — Length, about 12 mm. Head yellow, with the mouth parts brown. Body pale greenish yellow, deeply constricted between the segments. Each segment has a transverse row of ten moderately sized tubercles, from each of which arises a cluster of from six to twelve long, whitish, diverging hairs, besides which, scattered over the surface, are short hairs which are enlarged at the tip. Legs yellow, long and slender.

Pupa. — Length, 11 mm. Diameter, 2 mm. Front obliquely truncated, with two irregular ridges extending up over the truncate part and along the dorsum on either side of the median line, diverging towards the metathorax, where they terminate in a pair of flattened, sharp-pointed projections, about as high as two-thirds of the diameter of the pupa. The ridges are higher, and toothed on the top of each segment. On the first five abdominal segments there is a row of short spines on each side, in line with the abdominal projections. These spines incline forward, and on the posterior side is a small tooth and two short diverging club-shaped bristles. The pupæ attach themselves by a cluster of fine hooks at the end of the abdomen to a button of silk spun by the caterpillar before pupating. The pupal stage lasts about a week.

So far as I can learn, nothing is known of the egg and early larval stages. Both Fitch and Riley expressed the opinion that there were two generations in a year, but it has not been observed. The moths are on the wing here in Amherst during the latter part of June.

Oxyptilus delawaricus.

Oxyptilus Delawaricus Zell., Verh. z.-b. Ges. Wien, XXIII., p. 318 (1873).

Oxyptilus delawaricus Wlsm., Pter. Cal. and Ore., p. 29, Pl. II., fig. 7 (1880).

Expanse of wings, 17 to 18 mm. Head, thorax and fore wings light reddish brown. Palpi projecting forward about the length

of the head, acuminate, lighter beneath and at the tip, the second segment tufted beneath at the end. Antennæ fuscous, dotted with white above. Abdomen reddish brown at the base, yellowish white beyond and indistinctly marked with whitish scales and lines, but not so conspicuously marked as *tenuidactylus*. Legs white, barred with dark brown.

Fore wings with a few whitish scales scattered along the costa, which is slightly shaded with fuscous beyond the middle. There is a faint brown spot on the cell before the middle, and an indistinct pale spot on the basal fourth of the hind margin. Two oblique white stripes cross the first lobe, dividing it into thirds, the outer stripe appearing again on the second lobe, while only a trace of the inner stripe is occasionally seen on the second lobe, extending along to the inner end of the fissure, which is edged with white and dark brown. The ground color of the lobes is often darker than the rest of the wing. The costal fringe from the outer white stripe to the apex is white, that within the fissure is brown, while the fringe on the rest of the second lobe is white, cut with brown at the apex, and from the anal angle along the hind margin to the middle of the lobe, beyond which in one or two places black scales are seen in the white fringe. Hind wings darker brown than the fore wings, and with the usual cluster of black scales in the fringe, near the apex of the third feather. Nine specimens examined.

Habitat. — Canada, New Hampshire, Massachusetts, California. Early stages and food plant unknown.

Oxyptilus ningoris.

Oxyptilus ningoris Wlsm., Pter. Cal. and Ore., p. 26, Pl. II., fig. 6 (1880).

Expanse of wings, 15 to 20 mm. Head and thorax dark grayish brown. Palpi clothed with close scales, second segment untufted. Antennæ brownish, dotted with white above. Abdomen grayish white at the base, brownish fuscous beyond, with three pairs of slender white streaks diverging from the front to the back of each of the anterior segments; beyond them crossed by lines of whitish scales. Legs white and banded with brownish fuscous.

Fore wings dull grayish brown, sprinkled with whitish scales along the costa, with two oblique white stripes across the lobes and a small white spot at the end of the fissure, connected with the first oblique stripe by the white of the fringes, which beyond

this are brownish, except on the outer end of the costa of the first lobe and in the concave outer border of the second lobe, where they are white. There is also an inconspicuous white spot on the basal fourth of the hind margin, and a similar ill-defined spot near the middle of the wing. Hind wings brownish fuscous, the first feather barred with white beneath and the third feather widely barred with white and with blackish scales in the fringe on both sides towards the outer end. Six specimens examined.

Habitat.—California, Oregon. Early stages and food plant unknown.

Oxyptilus tenuidactylus.

Pterophorus tenuidactylus Fitch, N. Y. Rep., Vol. I., p. 848 (1854).
Oxyptilus nigrociliatus Zeller, Verh. z.-b. Ges. Wien, XXIII., p. 322 (1873).
Oxyptilus nigrociliatus Wlsm., Pter. Cal. and Ore., p. 31, Plate II., fig. 8 (1880).
Oxyptilus delavaricus Forbes, 3d Ill. Rep., p. 91, Plate X., fig. 2 (1885).
Oxyptilus nigrociliatus Saund., Inj. Ins., p. 314, figs. 326-7 (1889).

Expanse of wings, 12 to 15 mm. Head and thorax dark tawny brown, with a tinge of coppery red; posterior part of the thorax white. Palpi ascending, reaching above the top of the head, slender, not tufted. Antennæ black, dotted with white above. Abdomen of the same color as the wings, with two diverging white lines on the top of the third segment, and the fifth strongly marked with white above except in the middle line. Legs white and banded with dark brown.

Fore wings dark tawny brown, with a tinge of coppery red in certain lights. Two oblique white stripes cross the lobes, the inner one being the wider, and both more or less indistinct or wanting on the second lobe. There is a faint indication of a white spot near the middle of the wing and a similar one at the inner end of the fissure. Fringes white on the apical part of the costa and on the outer margin, cut with blackish at the apex and anal angle of each lobe, and also blackish in the fissure and on the outer part of the hind margin of the second lobe. Hind wings of the same color as the fore wings, with the first feather barred with white beneath and the third feather white in the middle, beyond which the fringe on both sides is thickened by heavy black scales. Fifty-eight specimens examined.

I have before me one specimen from the National Museum, labelled, in Zeller's handwriting, "Oxyptil. nigrociliatus Z., N.

m." It also has a printed label, "Collection C. V. Riley," and erefore it is probable that this specimen was determined by Zeller imself. I also have two specimens given me by Lord Walsing-am which he took in California. Although Professor Zeller de-lared Lord Walsingham's Californian specimens to be identical ith his *nigrociliatus*, yet, because of the lighter color of the Cali-rnian specimens, his lordship wrote: "It is open to question how r the two forms may be entitled to be considered distinct; but I ust leave it to be decided by some one who has a more extended ries of the undoubted *tenuidactylus* to refer to." I have the types Fitch in my possession, and there are two specimens of *tenui-actylus*, one of which is a male, from which the figures of the enitalia on Plate VI. were drawn. I have carefully compared is with the genitalia of the Californian specimens, as well as her eastern specimens, and find that there is absolutely no dif-rence. There is, therefore, no doubt that Lord Walsingham as correct in considering *nigrociliatus* the same as *tenuidactylus*, d that his Californian specimens are light varieties of the same ecies. I have a specimen from Philadelphia as light as any of y Californian specimens received from Lord Walsingham, and e taken in South Abington, Mass., which is as light in color as e lightest specimen from California. This, with many others, as taken July 19, 1881, by Mr. J. Elwyn Bates, who found them ying around blackberry bushes in large numbers.

Habitat. — Massachusetts, New York, Delaware, Maryland, est Virginia, Illinois, Ontario, Colorado, California. Food, ackberry. This species has been bred from blackberry by Prof. illiam Saunders and also by Prof. S. A. Forbes.

"About the middle of June the larva reaches full growth, when is about four-tenths of an inch long, of a pale greenish-yellow lor, streaked with pale yellow, and with transverse rows of ining tubercles, from each of which arise from two to six reading hairs of a yellowish-green color. The head is small, le green, with a faint brown dot on each side.

"When the larva is about to change to a chrysalis, it spins a ose web of silk on a leaf or other suitable spot, to which the rysalis is attached. This is less than three-tenths of an inch ng, pointed behind, enlarging gradually towards the front, here, near the end, it slopes abruptly to the tip. Its color is le green, with a line along the back of a deeper shade, margined each side with a whitish ridge; it is also more or less hairy. about a week or ten days the chrysalis changes to a darker lor, shortly after which the perfect insect escapes." (Saunders.)

Genus PLATYPTILIA Hüb., Verz. bek. Schm., p. 429 (1826).

Front with a conical projection, covered by a longer or shorter tuft of scales. Labial palpi long, slim, porrect or slightly ascending, closely scaled, the third segment filiform and shorter than the second. Legs long and slim, the tibiæ with darker scales and sometimes thickened at the end and also in the middle of the hind tibiæ.

Fore wings fissured about one-third of their length, the lobes, especially the second, wider at the outer end than at the base, each with a distinct anal angle, the first falcate and the second convex on the outer margin. The cell is nearly rectangular at the outer end, and veins 5 and 6, as well as the cross vein, are very weak. Two internal veins are present. Vein 2 arises from the outer third of the median vein and ends in or near the anal angle of the second lobe, while vein 3 ends in the middle and 4 in the apex of the same lobe. Vein 7 arises a little below the anterior angle of the cell and ends in or near the anal angle of the first lobe; 8 and 9 are from a stalk which arises from the anterior angle of the cell, and 8 ends in the apex, while 9 ends in the costa; 10 and 11 are somewhat remote from each other and from the stalk of 8 and 9. The first feather of the hind wings has a blunt apex, and is wider towards the outer end than at the base. Veins 7 and 8 arise separately from the base of the wing, approach very near to each other at the basal third and end at the widest part of the feather, one in the costa a little before the apex, and the other in the outer margin behind the apex. The second feather has an acute apex and a distinct anal angle; and vein 3, arising a little before the end of the cell, ends in the anal angle, while 4 arises from the end of the cell and ends in the apex of this feather. The third feather is narrow and tapers gradually to the apex, but there is usually a slight enlargement indicating the anal angle near the middle of the hind margin. A cluster of black scales more or less pronounced occurs in the fringe of the hind margin. One internal vein runs through the middle of this feather and a second terminates at the end of the second fissure.

The characters of the genitalia are represented in plates V., VII. and VIII.

SYNOPSIS OF THE SPECIES.

Palpi and frontal tuft much longer than head,	*marginidactyla.*
Palpi and frontal tuft not longer than head,	2.
With a dark triangle on the outer third of costa,	3.
Without a dark triangle on the outer third of costa,	13.
Cluster of dark scales in the middle of fringe of third feather,	4.
Cluster of dark scales beyond the middle,	10.
Hind tibiæ white, banded with dark near middle and end,	5.
Hind tibiæ without these characters,	6.
More than half the space between spurs white,	*carduidactyla.*
Less than half the space between spurs white,	*percnodactyla.*
Ground color of fore wings pale fawn,	7.
Ground color of fore wings whitish,	8.
Expanse of wings 36 mm.,	*grandis.*
Expanse of wings 20 mm.,	*fragilis.*
Expanse of wings 30 mm.,	*albidorsella.*
Expanse of wings 20 mm.,	*shastæ.*
Expanse of wings 25 mm.,	9.
Costa black between stripes on first lobe,	*orthocarpi.*
Costa not black between stripes on first lobe,	*albida.*
Fore wings reddish fuscous,	11.
Fore wings pale gray marked with black,	12.
Markings dark brown,	*acanthodactyla.*
Markings light brown,	*edwardsii.*
Thorax white,	*pica.*
Thorax gray,	*cosmodactyla.*
First lobe with two light cross lines or stripes,	14.
First lobe without cross lines or stripes,	15.
Costa cinnamon brown, hind margin white,	*albicans.*
Fore wings white shaded with brownish scales at base and costa,	*petrodactyla.*
Fore wings brownish gray,	*tesseradactyla.*
Fore wings cinereous,	*modesta.*
Fore wings cinnamon brown,	16.
Second segment of palpi enlarged with scales,	*albiciliata.*
Second segment of palpi not enlarged with scales,	*adusta.*

PLATYPTILIA PICA.

ıblyptilus pica Wlsm., Pter. Cal. and Ore., p. 21, Plate II., fig. 1 (1880).

I have never seen this species, and therefore repeat Lord Walgham's description: —

"Head and palpi cinereous, dusted with white scales. Antennæ ıereous, faintly dotted with whitish above. The thorax white ıched with cinereous above and at the sides, with two black ɔts behind.

"Fore wings white, dusted with cinereous along their costal half before the fissure; the costa fuscous, dotted with white; a blackish spot before the middle of the wing touching the costal shade; another nearer to the base below it; a blackish fuscous, triangular, costal patch before the fissure, followed by a conspicuous white space, beyond which is a fuscous shade, crossing both lobes, divided by a white line running parallel to the apical margin, on which the cilia are white, dotted with some fuscous. The dorsal half of the wing is less shaded or dusted than the costal, and contains two short, oblique, blackish dashes near the middle, the second being followed by a straight streak of brownish fuscous scales running parallel to the dorsal margin. The cilia on the dorsal margin are white, with two distinct tooth-like tufts of black scales; the cilia within the fissure are fuscous.

"Hind wings fuscous brown, with cilia of all the lobes the same color, except on the dorsal margin of the third, where they are white, irrorated with black scales along the basal half, and bearing a conspicuous projecting triangular tuft of black scales beyond the middle, and a few more below the apex of the lobe.

"The abdomen is white above and beneath, with a fuscous line along each side, which also crosses it above near the base, and again below the middle. The third pair of legs are annulated with white and fuscous brown, the bases of the white spurs being also fuscous. Expanse, 23 mm.

"It is allied to *A. acanthodactylus* and *A. cosmodactylus* of Huebner."

Habitat. — California. Early stages and food plant unknown.

PLATYPTILIA COSMODACTYLA.

Alucita Cosmodactyla Hüb., Aluc., Plate VII., figs. 35, 36 (1825).
Amblyptilus cosmodactylus Wlsm., Pter. Cal. and Ore., p. 23, Plate II., figs. 2–4 (1880).

Expanse of wings, 18–21 mm. Head, thorax and fore wings pale gray, finely striated with black; a triangular black spot on the outer third of the costa, followed by a small white costal spot, which is in turn followed by a broad black band edged on the outside with white, which crosses the lobes diagonally. On the second lobe the white cuts a dark basal portion twice at equal distances; costa of the wing dark gray with a series of white dots. Fringes blackish basally, white externally. Hind wings dark grayish brown, with a large cluster of black scales beyond the middle of the fringe of the third feather, and a small black cluster on the apex.

Habitat.— Europe, California, Oregon. Food, *Stachys*, *Aquilegia*, *Geranium*, *Orthocarpus*. "Larva, from pale green to purplish pink; dorsal line dark gray; subdorsal white, conspicuous; lateral and spiracular whitish, interrupted; head dark reddish fuscous, almost black." (Meyrick.)

PLATYPTILIA ACANTHODACTYLA.

Alucita Acanthodactyla Hüb., Aluc., Plate V., figs. 23, 24 (1825).

Expanse of wings, 18–21 mm. Head, thorax and fore wings reddish fuscous, marked very similarly to *cosmodactyla*, but may be separated by the ground color of the fore wings.

Habitat. — Europe, South Africa, New York. Food, *Stachys*, *Mentha*, *Ononis*, *Calamintha*, *Pelargonium* and *Euphrasia*.

I have a single specimen of this species, taken at West Farms, N. Y., by Mr. James Angus.

"Larva, from pale green to deep purple; dorsal line dark gray; subdorsal, lateral, and sometimes spiracular whitish, interrupted; head yellowish gray or yellowish brown, blackish-marked." (Meyrick.)

PLATYPTILIA EDWARDSII.

Platyptilus Edwardsii Fish, Can. Ent., Vol. XIII., p. 72 (1881).

Expanse of wings, 22–27 mm. Head and thorax ochreous brown; frontal tuft short and blunt, brown above, whitish beneath. Palpi ascending, extending beyond the frontal tuft; antennæ finely ciliated, dotted above with dark scales, cinereous beneath. Abdomen ochreous, slender. Legs ochreous brown, hind tibiæ and all the tarsi paler.

Fore wings reddish brown, darker on the costa; triangular costal spot dark brown, bordered on the outside by whitish scales. A small brown spot occurs near the hind margin at the basal fourth, another near the costa at the basal third, and a transverse white line at the apical third of the lobe. The first lobe with a dark longitudinal spot half way between the costa and hind margin; second lobe dark at the anal angle. Fringes whitish, with a patch of dark scales before and another just behind the apex of the costal triangle. Hind wings reddish brown; fringes brown, whitish at base of hind margin and bearing a small patch of dark scales just before the apex.

Habitat. — Maine, Massachusetts. Early stages and food plant unknown.

Platyptilia carduidactyla.

Pterophorus carduidactylus Riley, Mo. Rep., Vol. I., p. 180, Plate II., figs. 13, 14 (1869).
Platyptilus cardui Zell., Stett. Ent. Zeit., Vol XXXII., p. 179 (1871).
Platyptilia cardui Zell., Beitr., p. 118 (1873).
Platyptilus cardui Wlsm., Pter. Cal. and Ore., p. 7, Plate I., fig. 6 (1880).
Platyptilus cardui Riley, Gen. Index Ent. Rep. Mo., p. 83 (1881).

Expanse of wings, 23 mm. Head, thorax and abdomen tawny yellow. Legs tawny yellow, except the tarsi, which are nearly white, spotted with dark brown; spurs brown, with darker tips.

Fore wings tawny yellow, fissure extending in about one-fourth of the length of the wing; triangular spot dark brown, its outer margin slightly concave; three dark diffuse longitudinal spots, one on the basal third of the wing near the costa, one near the hind margin, nearer the base than the latter, and one on the outer third of the hind margin. Two paler transverse lines cross the outer portion of the wing, one bordering the triangular spot behind and curving across the lower lobe towards the anal angle, the other very near and parallel to the outer margin. The space between these two lines usually darker than the ground color. Fringes dark basally, whitish outwardly except three brown patches of scales, one in the middle of hind margin, one on the anal angle and a smaller one half-way between. Hind wings ashy brown. Fringes concolorous, with a patch of very dark scales about half way on hind margin of third feather, and a few scattering scales about half-way between that and the base.

Habitat. — New York, Pennsylvania, Illinois, Missouri, Texas, California, Washington. Food, Thistle (*Cirsium lanceolatum*).

"*Larva.* — Average length, 0.60. Largest in the middle of the body, tapering thence each way. Color light straw yellow, greener when young. Somewhat darker, partly translucent, dorsal, subdorsal, and stigmatal lines. Two lateral rows of black spots, the lower spots rather smaller and placed behind the upper ones. A third row above these, and others along the back, but so small that they are generally imperceptible with the naked eye, except on the thoracic segments, being especially distinct on segment 2. Head small, black, sometimes inclining to brown. Cervical shield black, divided longitudinally in the middle by a lighter line. Caudal plate also black. Segment 11, besides the spots above men-

tioned, has two transverse black marks, the posterior one the largest. Thoracic legs black, the others of the same color as the body.

"*Pupa.* — Average length, 0.45. Soft, dull yellow, with a lateral dusky line each side of dorsum, and another, less distinct, each side of venter. Also dusky about the head and wing-sheaths." (Riley.)

Platyptilia percnodactyla.

Platyptilus percnodactylus Wlsm., Pter. Cal. and Ore., p. 8, Plate I., fig. 7 (1880).

Expanse of wings, 22 mm. Head and thorax pale brown; antennæ spotted on the upper side with white and brown. Abdomen brownish, paler at the base. Legs whitish, slender, slightly enlarged, and tinged with brownish at the end of the segments. Spurs pale.

Fore wings pale brown with much paler blotches, one reaching from the base of the fissure to the costa, another below the dark-brown costal triangle and another at the base of the costal margin; a pale streak crosses the wing, parallel to the outer margin, which is brownish; a brown line at the base of the fringes, which are brown except within the fissure and near the anal angle; a few brown scales near the middle of the hind margin. Hind wings brown, the third feather paler than the others, and with a few fuscous scales in the fringe of the hind margin of the third feather.

Habitat. — California. Early stages and food plant unknown.

Platyptilia shastæ.

Platyptilus shastæ Wlsm., Pter. Cal. and Ore., p. 14, Plate I., fig. 11 (1880).

As I have no example of this species, I quote Lord Walsingham's description: —

"Head white; palpi white, touched with cinereous at the sides; antennæ dotted above. Thorax dusted with cinereous.

"Fore wings narrow, whitish, dusted with cinereous atoms, especially along the costa; the triangular costal patch brown, followed by the usual pale space; a brown line along the base of the white fringes; a very slender whitish line, running parallel to the apical margin, terminates in a white dash on the costa, reaching to the extreme apex; the antemedian dots scarcely indicated. Hind wings pale cinereous, the third lobe perhaps slightly the

lightest in color; fringes nearly unicolorous, pale cinereous, scarcely paler at their bases. Abdomen yellowish white. The third pair of legs cinereous, slightly whitish below each joint and on the spurs and feet. Expanse 20 mm."

Habitat. — California.

"This species may be distinguished by its slender appearance and narrow fore wings, which are so delicately dusted as to be of almost the same shade as the pale cinereous hind wings, which separate it at once from any of its allies now described."

PLATYPTILIA FRAGILIS.

Platyptilus fragilis Wlsm., Pter. Cal. and Ore., p. 16, Plate I, fig. 12 (1880).

Expanse of wings, 19 mm. Head and thorax white, sprinkled with yellowish scales; palpi slightly cinereous; abdomen yellowish; legs yellowish white, brownish at the joints.

Fore wings fawn color with yellowish tinge; the two antemedian spots and the triangular costal patch brown; outer margin brownish. Fringe white with a fine brown line at its base. Two brown dashes in the fringes of the hind margin before the anal angle. Hind wings very pale brownish white with paler fringes.

Habitat. — California. Early stages and food plant unknown.

PLATYPTILIA ORTHOCARPI.

Platyptilus orthocarpi Wlsm., Pter. Cal. and Ore., p. 11, Plate I, fig. 9 (1880).

Expanse of wings, 25 mm. Head and thorax whitish, slightly tinged with ochreous; frontal tuft short. Hind legs whitish, marked with fuscous on the outside, with white annulations below each segment; spurs and feet white.

Fore wings dusted with ochreous and brown scales, especially on the costa; triangular costal patch and a dash at the end of the first third of the wing very dark fuscous, and more produced toward the apex than in *albida;* space beyond the triangular patch and a streak parallel to the outer margin white, with the space between them brown. Hind wings fuscous brown; fringes fuscous with a white line at the base.

Habitat. — Oregon. Food, *Orthocarpus.*

Platyptilia albida.

Platyptilus albidus Wlsm., Pter. Cal. and Ore., p. 10, Plate I., fig. 8 (1880).

Expanse of wings, 24 mm. Head and thorax white, with a bluish tinge. Antennæ white dotted with brown above. Abdomen white streaked with fuscous. Hind legs dark ashy in color; spurs and feet slightly paler on the inner side.

Fore wings bluish white, with brownish scales, especially along the costa to the brown triangular spot, beyond which is a pale stripe running parallel to the outer margin across both lobes of the wing; another pale line near the outer margin; the space between these pale lines is grayish brown except near the costa, where it is brownish; a brown stripe between this and the fringes. Two indistinct brown spots on the inner half of the wing, the lower one much nearer the base than the upper one; a brown line at the base of the fringe, which is white except at the anal angle. Hind wings brown; fringes brown, a little paler on the hind margin of the third feather.

Habitat. — Southern Oregon, California. Early stages and food plant unknown.

Platyptilia albidorsella.

Platyptilus albidorsellus Wlsm., Pter. Cal. and Ore., p. 13, Plate I., fig. 10 (1880).

Expanse of wings, 30 mm. Head and thorax white, with a few scattered fuscous scales; frontal tuft short. Legs whitish tinged with cinereous; feet and spurs paler.

Fore wings white, thickly sprinkled with brown, forming a widening streak from the base of the wing to the triangular patch, beyond which it is paler and crossed by a white costal patch and a white line near the outer margin and parallel to it. Fringes ashy, with a brown line at the base. Hind wings white, thickly dusted with brown. Fringes paler brown, much paler at the base.

Habitat. — California. Early stages and food plant unknown.

Platyptilia grandis.

Platyptilus grandis Wlsm., Pter. Cal. and Ore., p. 6, Plate I., fig. 5 (1880).

Expanse of wings, 36 mm. Head and thorax pale fawn color; antennæ brownish fawn color, spotted with white above; frontal tuft fawn color, shorter than in allied species. Legs very pale, the hind tibiæ with their extremities darker.

Fore wings pale fawn color, with the costa and triangular blotch fuscous; two brownish, elongated dots near the middle of the wing, the larger one nearer the base. The lobes are crossed by a pale wavy streak parallel and near to the outer margin; a brown line at the base of the fringes, which are dark fuscous except near the anal angle, where they are pale. Hind wings brownish fawn color. Fringes pale except on the hind margin of the third feather, where they are brownish.

Habitat. — California. Early stages and food plant unknown.

PLATYPTILIA MODESTA.

Platyptilus modestus Wlsm., Pter. Cal. and Ore., p. 18, Plate I., fig. 14 (1880).

As I have no example of this species, I give a copy of Lord Walsingham's description: —

"Head and palpi cinereous; antennæ slightly dotted above.

"Fore wings very narrow, cinereous, with a slight ochreous tinge towards the dorsal margin. The costa sprinkled and shaded with fuscous, the fuscous shade widening towards the fissure, forming an elongate but indistinct triangular costal blotch. The apical portion of the wing more or less shaded with fuscous, and a fuscous line along the base of the cilia on the apical margin, which are whitish at their points. The cilia within the fissure and those along the dorsal margin before the anal angle white, the latter containing a few dark scales. Hind wings cinereous; the cilia slightly paler, especially along their bases. Posterior legs cinereous; the feet slightly paler. Expanse 22 mm."

Habitat. — California. Early stages and food plant unknown.

PLATYPTILIA PETRODACTYLA.

Pterophorus petrodactylus Walk., Cat. Lep. Het., Vol. XXX, pp. 940, 941 (1864).

Platyptilus petrodactylus Wlsm., Pter. Cal. and Ore., p. 20, Plate II., fig. 15 (1880).

Expanse of wings, 23 mm. Head, thorax and abdomen shaded cinereous. Legs cinereous, slightly thickened at the joints; the spurs apparently of equal length.

Fore wings white, shaded with cinereous or ashy brown; costa brownish beyond the middle; an oblique brownish fuscous line, starting from the costa before the apex, extends inward more obliquely than the outer margin, but does not reach the fissure. This line is widest on the costa, tapering to a point inwardly, and

is darker at its lower end. Fringes white within the fissure, with a cinereous line near their bases, shaded with fuscous at the anal angle. Hind wings pale cinereous; fringes slightly darker towards the end of the feathers.

Habitat. — Arctic America. Early stages and food plant unknown.

Platyptilia adusta.

Platyptilus adustus Wlsm., Pter. Cal. and Ore., p. 5, Plate I., fig. 4 (1880).

Expanse of wings, 23 mm. Head, frontal tuft, thorax and abdomen fawn color, with a brownish tinge. Legs pale fawn color, with the feet and anterior parts of the tibiæ slightly paler.

Fore wings fawn color, somewhat streaked with a paler tint; the costa much darker. Fringes but little paler than the wings, but with a fine brown basal line. Hind wings fawn color, the first and second feathers slightly darker than the fore wings.

Habitat. — California. Early stages and food plant unknown.

Platyptilia albiciliata.

Platyptilus albiciliatus Wlsm., Pter. Cal. and Ore., p. 17, Plate I., fig. 13 (1880).

Expanse of wings, 24 mm. Head cinnamon brown; frontal tuft short. Thorax grayish brown. Hind legs cinereous; feet and spurs paler.

Fore wings cinnamon brown, with a slight grayish tinge on the costa and outer margin. Fringes whitish except at the base, where they are of the same color as the wing. Hind wings pale brown, with the fringes paler at the base.

Habitat. — California. Early stages and food plant unknown.

Platyptilia albicans.

Platyptilia albicans Fish, Can. Ent., Vol. XIII., p. 71 (1881).

Expanse of wings, 22 mm. Head and thorax cream color, frontal tuft short and blunt. Palpi extending beyond frontal tuft, slightly ascending. Antennæ cinnamon brown, dotted above with white. Abdomen ochreous, lighter at base. Legs whitish, anterior and middle femora and tibiæ cinnamon brown, sprinkled with whitish scales; tarsi cinereous, first two segments whitish interiorly; posterior tibiæ cream color, brownish just before the spurs.

Fore wings creamy white along the hind margin, on the costa cinnamon brown; costal triangular spot cinnamon brown, bor-

dered outwardly above the fissure by a broad white line; below the fissure its apex is continuous with the brownish color of the second lobe. Both lobes cinnamon brown, with a transverse white line not reaching the hind margin of the second lobe. Fringes cream color, sprinkled with cinnamon brown. Hind wings cinnamon brown, with fringes concolorous.

Habitat. — Nevada. Early stages and food plant unknown.

PLATYPTILIA TESSERADACTYLA.

Alucita tesseradactyla Linn., Fn. Suec., p. 370 (1761).

Expanse of wings, 16–20 mm. Head, palpi and frontal tuft grayish brown. Antennæ whitish, dotted above with dark brown. Thorax gray in front, white behind.

Fore wings whitish, heavily dusted with brownish gray. The somewhat indistinct brownish triangle on the outer third of the costa is followed by a whitish spot, and a subterminal white line crosses both lobes.

Habitat. — Europe, Massachusetts. Food, *Gnaphalium dioicum*, *G. arenarium*.

"The egg is pale green, smooth and somewhat elongated, and the larva in its earliest stage is clear white with isolated hairs. Head, thoracic and anal shields black. Later (in September) the dorsal and lateral rows of rust-brown points appear, and in March, after hibernating, it becomes stout without increasing very much in length. The head, thoracic and anal shields are dark brown; dorsal stripe is crimson rust color; the subdorsal and lateral lines are of the same color but finer. The ground color of the body is yellowish above and rust red beneath. The adult larva is a little smaller at each end and cylindrical in the middle. The head is small and black, the thoracic shields small, black divided by a light line. The color of the body is dark ferruginous brown. On the back stand whitish flecks with two pairs of black tubercles on each segment, of which the hinder are placed farther from each other than those in front; similar tubercles occur on the sides, from which arise long light hairs. The anal shield and legs are dark brown. These larvæ frequently vary in the tone of the color." (Gartner.)

PLATYPTILIA MARGINIDACTYLA.

Pterophorus marginidactylus Fitch, N. Y. Rep., Vol. I., p. 848 (1854).
Pterophorus nebulædactylus Fitch, N. Y. Rep., Vol. I., p. 849 (1854).
Platyptilus Bertrami Roessl., Wien. Mts., Vol. VIII., p. 54 (1864).
Platyptilus Bischoffii Zell., Stett. Ent. Zeit., Vol. XXVIII., p. 333 (1867).
Platyptilia Bertrami Zell., Stett. Ent. Zeit., Vol. XXXIV., p. 135 (1873).
Platyptilia Bischoffii Zell., Verh. z.- b. Ges., p. 317 (1873).
Pterophorus cervinidactylus Pack., Ann. Lyc. N. Y., Vol. X., p. 266 (1873).
Platyptilus bertrami Wlsm., Pter. Cal. and Ore., p. 3., Plate I., fig. 3 (1880).
Platyptilia bertrami Tutt, Mon., p. 31 (1891).
Platyptilia Bertrami Mey., Brit. Lep., p. 434 (1895).
Platyptilia Bertrami Hof., Deut. Pter., p. 55 (1895).

Expanse of wings, 22–28 mm. Head, palpi, frontal tuft, thorax and abdomen pale ochre yellow, the collar and outside of the palpi sometimes a little darker. Palpi and frontal tuft of nearly equal length, extending forward of the head a distance equal to the length of the head. Antennæ whitish, dotted above with dark brown. All the coxæ, femora, anterior and middle tibiæ brownish yellow on the outside, whitish within. Hind tibiæ whitish at the base, dull brown on the outer half. All the tarsi whitish, except in some examples the segments of the hind tarsi are touched with dull brown. Fore wings somewhat falcate at the end of the first lobe, pale ochre yellow, fuscous along the costal edge, broken by an oblique light shade above and a little beyond the end of the fissure, within which a darker shade extends from the costa across the cell containing two brownish dots, one on each angle of the cell. The anterior dot is seldom present and often both are absent. An elongated ochre yellow spot rests on the cell halfway between the discal dots and the base of the wing, a second elongated spot on the hind margin at the base and another near the middle of the wing. The lobes are somewhat darker at the outer end, sometimes with an indication of a pale subterminal line. Fringes whitish, with a darker shade outwardly, and with a dark-brown basal line which extends a little into the fissure. The darker ochre yellow spots are often extended so that nearly the whole surface of the wing is of this color. Hind wings dark ochreous fuscous, with a more or less distinct cluster of dark scales near the middle of the hind fringe of the third feather.

The genitalia are represented on Plate III., figs. 4 and 5. For the sake of comparison the genitalia of *P. ochrodactyla* are represented on the same plate, figs. 14 and 15. These were made from specimens received from Professor Zeller, and labelled in his own handwriting.

The above description was drawn up from one hundred and thirteen American specimens.

Habitat. — Europe; Canada, Maine, New Hampshire, Massachusetts, New York, Pennsylvania, Colorado, California, Oregon. Food, Yarrow (*Achillea millefolium*).

In some unpublished notes received from Mr. Charles Fish, I find the following statement: "Received from Mr. J. Elwyn Bates, on June 30, 1881, some eggs of *Plat. bischoffii*, which were laid June 24, to the number of twenty-four. They were elliptical in outline and somewhat flattened. The longer diameter was three-sevenths of a millimeter and the shorter diameter was three-tenths of a millimeter, and the surface was irregularly corrugated. When first deposited they were of a light cream color or almost hyaline with a glossy surface, but after two days they turned to a deep flesh color." There was no note made as to whether these eggs hatched, or not.

Different stages of the larva have been described by several writers in Europe, and the mature larva is briefly described as follows: "Larva green; dorsal line darker or somewhat brownish tinged; subdorsal and lateral gray whitish; subspiracular white; head whitish yellowish." (Meyrick.)

"The pupa is a little over half an inch long, with a longish beak in front, projecting at a slight angle downwards from the head; pointed at the tail; the wing cases of moderate length, well developed, and the ends of the leg cases projecting free from the abdomen. The color is bright pale green, dorsal line dark green, edged on the thorax with white; beak white above, rust color on the sides; there is a conspicuous streak on this rust color on the hind part of the thorax, and the same color also appears (but more faintly) on the abdominal point and at the tip of the leg cases; subdorsal line dark green, lateral line white. Ventral surface pale green, with darker green lines, and the wing-cases with whitish rays." (Porritt.)

The insects before me, so far as the labels indicate, were on the wing in Maine, June 24; Massachusetts, from the 10th to the 27th of June; New York, from June 23 to July 17; Missouri, in May; Colorado, from the 11th to the 16th of June; California, June 1 to 18.

I have seven European species of *Platyptilia* in my collection, all named by Professor Zeller. Five of these are males, and an examination of the genitalia proves that one which Zeller named *bertrami* is *ochrodactyla* and one named *ochrodactyla* is *bertrami*. They approach each other so closely in form and coloration that it is not surprising that they should have been considered conspecific for so long a time, and that there should have been so much discussion about the matter in the European journals. Mr. Tutt has given an excellent resumé of this discussion in his "Monograph of the Pterophorina of Britain." Mr. Tutt suggests that Haworth's *pallidactyla* is identical with *bertrami*, and in that case it should take precedence, but until this is adopted we must accept the name *marginidactyla* Fitch, which is ten years older than *bertrami*.

The types of Fitch now belong to my collections; and I have made a critical examination of the genitalia, and they agree perfectly with the genitalia of *bertrami*.

GENUS ALUCITA Linn., Syst. Nat., Ed. 10, p. 542 (1758).

Vertex smooth; front smooth or a little swollen, closely scaled; antennæ with a thickened basal segment. Palpi slim, porrect or somewhat ascending, the third segment shorter than the second, pointed and sometimes bent down a little. Anterior and middle tibiæ very slightly thickened at the end; hind tibiæ without thickening of scales. Abdomen moderately slim, the second and third segments not much longer than the others. Fore wings fissured half their length or a little more, the lobes running to a point and bent backward somewhat, especially the second lobe. Feathers of the hind wings all of the same form, linear and pointed, without a cluster of dark scales in the fringe of the third feather.

SYNOPSIS OF THE SPECIES.

Ground color of fore wings gray, ... *belfragei*.
Ground color of fore wings white, ... *montana*.
Ground color of fore wings yellowish white, ... *cinerascens*.

ALUCITA BELFRAGEI.

Aciptilus Belfragei Fish, Can. Ent., Vol. XIII., p. 142 (1881).

Expanse of wings, 18 mm. Head brownish gray. Palpi brown above, whitish beneath. Antennæ whitish, dotted with pale brown above. Thorax pale ochreous gray in front; hind portion and abdomen pale grayish ochreous, striped longitudinally with fine white lines and marked with dark streaks. Legs pale grayish; fore and middle femora striped longitudinally with whitish and

dark brown lines; tarsi pale ochreous, with shadings on the outer side; hind tibiæ and tarsi pale ochreous; spurs tipped with brown.

Fore wings pale ochreous gray, dusted with brown scales; an oblique dark-brown patch at the base of the fissure, bordered posteriorly with white; a small brown spot midway between this and the base of the wing; two longitudinal brown spots on the outer third of the costa of first lobe and one or two brown dots on the outer margin of the same lobe near the apex. Fringes pale brown except at the apex of the second lobe, where they are white. Hind wings brownish cinereous. Fringes pale brown.

Habitat. — Texas. Early stages and food plant unknown.

ALUCITA MONTANA.

Aciptilus montanus Wlsm., Pter. Cal. and Ore., p. 59, Plate III., fig. 14 (1880).

Expanse of wings, 16 mm. Head white, antennæ faintly dotted above with brownish. Thorax, abdomen and legs snow white; the fore and middle legs brownish on the inner side.

Fore wings snow white, sprinkled with ferruginous-brown scales, especially on the outer half of the costa; a spot of these scales before the base of the fissure runs obliquely to a darker spot on the costa, and this is nearly connected by a dark shade with another brown costal spot near the apex; a dark-brown fine streak on the outer half of the costa of the second lobe extends through the fringe under the apex; all of the rest of the fringe is snow white. Hind wings dusted with cinereous brown.

Habitat. — California, New York.

"The larva feeds upon different species of *Solidago*. The first examples were noticed on May 30. At this time they were found only on the under side of the leaves, later they occur on the upper as well. As a rule, they lie close to and parallel with the midvein. At least while young they eat out the parenchyma, leaving the epidermis.

"May 30 the larvæ were .1 of an inch and less in length; entirely white, except claws and mandibles. The body is not flattened at this stage. The first ring is broad, and the head may be well withdrawn into it. The tubercular hairs are spined, plainly seen under a moderate magnifying power.

"June 3 the largest had evidently moulted, length then .2 of an inch; pale green, eighth and ninth rings yellow. Lateral tufts more conspicuous. Dorsal line faint. Subsequent changes not noted until full-grown larva was described the latter part of June. Length .34 to .4 of an inch. Pale pea green, head paler; dorsal

stripe of three white lines, the middle one the finest and most clearly defined. The seventh, eighth and ninth rings yellow. The posterior subdorsal papilla of the body rings bears two unequal hairs, the anterior but one; above the spiracles and in front of them also is a papilla; below the same there are two, from which arise long hairs, five from posterior and ten or twelve from anterior, these are spread out fan-like; below these a prominent longitudinal fold. From the first ring proceed long hairs reaching over and beyond the head. Hairs all unbranched and plumose. The body is considerably flattened, so when looking down upon it the spiracles from either side may be seen at once, spiracles conical, rings black.

"The *pupa* is .3 of an inch in length; light green, some of them have a reddish stripe along dorsal part of the abdomen, the conical spiracles of such have the same hue. The upper part of the rings well clothed, especially at extremities and along the lateral ridges. Pupa fastens to a tuft of silk by means of the hooks of the last ring. Moth appears through greater part of July." (Kellicott.)

ALUCITA CINERASCENS.

Aciptilus cinerascens Wlsm., Pter. Cal. and Ore., p. 57, Plate III., fig. 13 (1880).

Expanse of wings, 19 mm. Head slightly ochreous; palpi very short; antennæ pubescent, pale ochreous. Thorax whitish, especially in front, where two indistinct dark lines run forward to the head. Abdomen pale ochreous. Legs whitish, the fore and middle pairs tinged with brown on the inner side.

Fore wings very pale ochreous, dusted thickly with brownish, forming a large spot before the base of the fissure; a subcostal spot before the middle and two small costal spots on the outer half of the first lobe. Fringes below the apex of first lobe and on the apex of the second lobe dark brown; pale subochreous within the fissure, with a brownish spot on the hind margin. Hind wings and fringes pale cinereous; under side pale brownish.

Habitat — California. Early stages and food plant unknown.

GENUS PTEROPHORUS Geoff., Hist. Ins., Vol. II., p. 90 (1764).

Vertex and front smooth; palpi short, not reaching beyond the head or but very slightly; porrect, or slightly ascending, the third segment short and sometimes bent down a little; antennæ with a thickened basal segment. Anterior and middle tibiæ only slightly thickened at the end; hind tibiæ without a thickening of scales.

Fore wings fissured about one-third of their length; both lobes pointed, the hind lobe in some species with a scarcely perceptible anal angle. Feathers of the hind wings unlike in form, with long fringes and without a black scale cluster. The upper angle of the cell is very acute, formed by the very oblique cross vein.

Synopsis of the Species.

1.	Ground color of the fore wings snow white,	2.
	Ground color of the fore wings pale sulphur yellow,	*sulphureodactylus.*
	Ground color of the fore wings pale straw color,	4.
	Ground color of the fore wings cream white,	5.
	Ground color of the fore wings very pale brownish gray,	6.
	Ground color of the fore wings ochre yellow,	7.
	Ground color of the fore wings brown or dark gray,	13.
2.	Expanse of wings less than 21 mm.,	*fishii.*
	Expanse of wings more than 21 mm.,	3.
3.	Expanse of wings between 23 and 25 mm.,	*elliottii.*
	Expanse of wings more than 25 mm.,	*homodactylus.*
4.	Costa of first lobe of fore wing indistinctly brownish,	*stramineus.*
	Costa of first lobe of fore wing not marked with brown,	*angustus.*
5.	Expanse of wings 24 mm.,	*helianthi.*
	Expanse of wings 28 mm.,	*lacteodactylus.*
6.	Fore wings with a brown spot at the end of the fissure,	*paleaceus.*
	Fore wings unspotted,	*inconditus.*
7.	With three or four terminal brown spots on outer margin of second lobe,	*kellicottii.*
	Without this character,	8.
8.	Pale ochre yellow without any markings,	*grandis.*
	With more or less markings,	9.
9.	An oblique reddish brown shade from costa to fissural spot,	*cretidactylus.*
	Without this character,	10.
10.	Second lobe of a brighter yellow than the rest of the wing,	*baroni.*
	Without this character,	11.
11.	A brown costal streak over the end of fissure,	12.
	Without this character,	*guttatus.*
12.	Expanse of wings 28 mm.,	*cineraceus.*
	Expanse of wings 22 mm.,	*gratiosus.*
13.	With tuft of scales near middle of hind tibiæ,	*monodactylus.*
	Without this character,	14.
14.	Expanse of wings less than 20 mm.,	*inquinatus.*
	Expanse of wings more than 20 mm.,	15.
15.	Costal region light yellowish brown,	*eupatorii.*
	Costal region dark,	16.
16.	Outer fourth of costa mostly white,	*grisescens.*
	Outer fourth of costa with but little white,	*lugubris.*

PTEROPHORUS FISHII.

Alucita fishii Fern., Can. Ent., Vol. XXV., p. 95 (1893).

Expanse of wings, 20 mm. Thorax and abdomen white. Legs white slightly tinged with brownish.

Fore wings white with a few brown scales scattered over the costal portion before the fissure, forming a faint costal triangular patch, beyond which are two equidistant brown spots on the costa. Fringes pure white. Hind wings and fringes pure white. Described from one specimen with the head wanting.

Habitat. — Nevada. Early stages and food plant unknown.

PTEROPHORUS HOMODACTYLUS.

Pterophorus homodactylus Walk., Cat. Lep. Het., Vol. XXX., p. 941 (1864).

? *Leioptilus hololeucos* Zell., Lep. Westk. Am., p. 23 (1874).

Lioptilus homodactylus Wlsm., Pter. Cal. and Ore., p. 50, Plate III., figs. 8, 9 (1880).

Expanse of wings, 22–27 mm. Head white, palpi and antennæ whitish. Thorax and abdomen white. Legs white, slightly tinged with cinereous.

Fore wings white, very slightly dusted on the costa with brownish scales; a brownish spot before and slightly below the base of the fissure; a group of indistinct brownish scales between this and the base of the wing; a faint indication of two brownish dots on the outer margin. Hind wings and fringes pure white, with a silky lustre. In some specimens the brownish spots are absent.

A variety of this species has the head brown behind and in front, the palpi brownish and antennæ dingy white. Fore wings more heavily dusted with brown scales, fringes tinged at the tips around the obsolete anal angle with pale cinereous. Hind wings and fringes very pale cinereous. Legs white, first two pairs touched with brownish on their inner sides.

A specimen of this species was sent by Lord Walsingham to Professor Zeller, who remarked: "Only larger, otherwise agreeing with *Lioptilus hololeucos* Zeller; on the right anterior wings it has also two dots."

Habitat. — South America, California, Oregon. Food, *Solidago*, *Eupatorium purpureum*.

"*Larva.* — Length, .55 of an inch; pale yellowish green; dorsal line sharply defined, white; subdorsal and stigmatal lines similar; the top of each ring from the second to the tenth bears a minute circle of white interrupting the dorsal line. The dorsal spaces of

each ring from the fourth to the eleventh bear a pair of tubercles on either side of the middle line, from these proceed rather long, stiff, hoary, smooth hairs; the thoracic and terminal rings have a single papilla in place of the pairs. These tubercles stand in a light stripe. Below them a single tubercle with similar appendages; below the spiracles a larger one with a minute one back of it bearing three or four hairs, also one above the line of the feet. Legs and ventral surface hairy. The anterior half of the first ring bears many hairs, which hang over the head somewhat. Spiracles round, rim white; back of each there is a short, stiff hair. Head almost colorless, except mouth organs and ocelli; epicranial suture deep; cranial lobes hemispherical, with scattered hairs.

"The pupa measures .45 of an inch. It is light pea green, turning white before the moth escapes. There is a clear dorsal space with an interrupted white line in the middle; also white lines on the lateral faces. The tubercles are set with hairs exactly as in the larva, so the pupa is quite conspicuously clothed; the head and thorax support shorter hairs arising singly from the surface; short, dusky hairs stand in rows on the wing covers, apparently outlining the veins; there is a similar row on the antennæ covers. The pointed cremaster ends with many hooklets, which fasten the pupa securely to the leaf, on which a tuft of silk has been spun by the larva. The thorax is quite obliquely truncated; seen from below, it is slightly bilobed, rendered so by the prominent origin of the antennæ covers; between the lobes there is a slight tufted tubercle." (Kellicott.)

PTEROPHORUS ELLIOTTII.

Alucita elliottii Fern., Can. Ent., Vol. XXV., p. 95 (1893).

Expanse of wings, 23–25 mm. Head very pale fuscous. Thorax and abdomen whitish fuscous. Legs white.

Fore wings white, tinged more or less with ochre yellow near the base and on the apical third of the costa; a very oblique streak of brown scales on the costa near the apex and a dark-brown spot before the fissure; a streak of irregular brown scales extends from the base of the wing to the fissure. Fringes white. Hind wings pure white, with a few ochre yellow scales scattered over the surface in some specimens. Fringes white.

Habitat. — New York. Early stages and food plant unknown.

Pterophorus subochraceus.

Lioptilus subochraceus Wlsm., Pter. Cal. and Ore., p. 53, Plate III., fig. 10 (1880).

? *Pterophorus lacteodactylus* Cham., Can. Ent., Vol. V., p. 73 (1873).

Having no example of this species from California, I copy Lord Walsingham's description: —

"Head whitish above; face and neck brownish; palpi very short, not projecting as far as the front of the head; antennæ whitish ochreous, with the basal joint brown.

"Fore wings pale subochreous, without spots or markings, except a rather oblique delicate ferruginous shade above the base of the fissure, reaching the costa before the apex; the cilia about the dorsal margin of the second lobe are slightly tinged with brownish. Hind wings very pale brownish straw color. Legs whitish.

"Expanse, 28 mm."

Habitat. — California. Early stages and food plant unknown.

I have the type of *lacteodactylus* before me, and the head and palpi agree perfectly with the above description, but the wings are somewhat worn. Without seeing an authentic specimen of *subochraceus*, I do not feel prepared to pronounce them identical. I have two specimens from Massachusetts which were supposed to be *subochraceus*, by Mr. Fish, and from which the drawings of the genitalia on Plate IV. were made. In these specimens the palpi are longer than in *lacteodactylus*, and I do not think they are the same.

Pterophorus helianthi.

Lioptilus helianthi Wlsm., Pter. Cal. and Ore., p. 54, Plate III., fig. 11 (1880).

Expanse of wings, 24 mm. Head and thorax whitish; palpi brownish; antennæ white, dotted with brown above. Abdomen whitish. Legs whitish, dotted with brown on the under side of the segments.

Fore wings cream white, with a few scattered brown scales; a brown spot before the base of the fissure and another between that and the costa, upon which is a brown line; the apex of each lobe sprinkled with brown, and on the apex of the first lobe are two or three small brown spots or dashes. Fringes cream white, tinged with brown on the outer margin. Hind wings very pale cinereous; fringes slightly darker about the ends of the feathers.

Habitat. — Southern Oregon. Food plant, *Helianthus*.

Pterophorus stramineus.

Lioptilus stramineus Wlsm., Pter. Cal. and Ore., p. 41, Plate III., fig. 3 (1880).

Expanse of wings, 19 mm. Head yellowish brown above and in front, yellowish white between the antennæ; palpi and antennæ pale straw color above, brownish beneath. Thorax, abdomen, legs and spurs pale straw color. Fore wings straw color, with a slightly brownish streak extending from the base along the lower half of the wing, and one running obliquely on the costa, pointing inward toward a brown spot at the base of the fissure. Fringes grayish, slightly tinged with brown. Hind wings and fringes pale grayish brown.

Habitat. — Southern Oregon. Early stages and food plant unknown.

Pterophorus angustus.

Lioptilus angustus Wlsm., Pter. Cal. and Ore., p. 43, Plate III., fig. 4 (1880).

Expanse of wings, 18 mm. Head very pale straw color; palpi straw color above, tinged with brownish on the sides; antennæ whitish, with indistinct ochreous spots above. Thorax and abdomen pale straw color. Legs whitish.

Fore wings narrow, very pale straw color tinged with ochreous; a dark fuscous dot at the base of the fissure. Fringes very pale straw color except at the outer end of the fissure above and below where they are grayish. Hind wings pale cinereous; fringes paler.

Habitat. — California. Early stages and food plant unknown.

It differs from *stramineus* in having no costal streak.

Pterophorus sulphureodactylus.

Pterophorus sulphureodactylus Pack., Ann. Lyc. Nat. Hist., N. Y., Vol. X., p. 266 (1873).

Lioptilus sulphureus Wlsm., Pter. Cal. and Ore., p. 48, Plate III., fig. 7 (1880).

Expanse of wings, 25 mm. Head ochreous. Palpi whitish yellow, streaked with ochreous; antennæ long, yellowish, tinged with fuscous. Thorax and abdomen sulphur yellow, streaked with ochreous scales. Legs whitish ochreous, streaked with brown.

Fore wings with the first lobe produced into a very acute point, the second lobe broad halberd-shaped, unspotted, clear sulphur yellow, slightly tinged with brownish on the outer fourth of the costa. A minute brown dot before the base of the fissure.

Fringes pale yellowish white, cinereous on the hind margin. Hind wings whitish, thickly dusted with cinereous. Fringes concolorous.

Habitat. — California. Early stages and food plant unknown.

PTEROPHORUS MATHEWIANUS.

Leioptilus Mathewianus Zell., Lep. Westk. Am., p. 23 (1874).

Expanse of wings, 24 mm. Head brownish gray behind; palpi whitish gray; antennæ dust gray, faintly annulated on the basal third with whitish. Thorax and abdomen whitish gray. Legs light gray, all the femora and tibiæ brownish ochre, lightest on hind legs.

Fore wings pale reddish gray, sprinkled with black scales, especially on the margin. A diffuse brown dot on the cell, nearer to the base of the wing than to the fissure. Before this is a more distinct dot, variable in form and size, and sometimes a pale dot at the base of the second lobe. A white longitudinal spot under the first-named dot, and before the same an almost pure white stripe runs to the fold, where it widens and sends out a slender line through the middle of the second lobe to its outer margin. A dark-brown line bordered with white on each side runs to the dot on the fissure, and a brown indistinct dot rests on the middle of the first lobe; two brown spots on the apex of the second lobe and a short brown cross line at the base of the fringes of the outer margin. Hind wings clear brownish gray, with a silky luster.

Habitat. —Vancouver Island. Early stages and food plant unknown.

PTEROPHORUS PALEACEUS.

Leioptilus paleaceus Zell., Beitr., p. 126 (1873).
Lioptilus paleaceus Wlsm., Pter. Cal. and Ore., p. 41, Plate III., fig. 2 (1880).
Leioptilus sericidactylus Murtf., Am. Ent., Vol. III., p. 235 (1880).

Expanse of wings, 21-25 mm. Head yellowish brown, pale between the antennæ; antennæ whitish. Thorax dull yellowish white. Abdomen dull yellowish, with fine longitudinal brownish lines. Legs yellowish white, with fuscous shadings on the under side.

Fore wings very pale brownish gray, with a brownish spot before the fissure. Fringes concolorous with the lobes. Hind wings of the same color as the fore wings. Fringes paler, except at the apices.

Habitat.—Ohio, Illinois, Missouri, Texas, California, Oregon. Food, Iron Weed (*Vernonia noveboracensis*).

An examination of the genitalia of the types of *paleaceus* and also of *sericidactylus* proves them to be identical.

"*Larva.*—Length, 0.55 inch; diameter, 0.10 inch; form, subcylindrical. Color when young, dingy white, with a tinge of green, becoming at maturity pale glaucous, often varying, especially in the late fall brood, to dull salmon. Dorsal hairs proceeding from prominent tubercles, and of two sizes in each tuft, each of the shorter ones tipped with a minute pellucid bead of viscid fluid, to which pollen and bits of leaves often adhere. Lateral ridge well defined. Prolegs long and narrow. When mature, the larva weaves a dense mat of silk, upon which it extends itself, remaining quiescent for two or three days, the dorsal surface acquiring, meanwhile, a translucent lilaceous hue, with three greenish-white longitudinal stripes, of which the medio-dorsal is most distinct and continuous.

"*Pupa*, with ventral surface closely appressed to the mat of silk, to which the anal hooks are firmly attached. An upright or inverted horizontal position seems to be preferred, although there is no thoracic band or other support for the anterior part of the body.

"Average length, 0.45; diameter, same as larva, tapering rather abruptly from seventh abdominal segment backward. Wing sheaths narrow, free at the blunt tips. Dorsum with prominent subdorsal ridges. Color and markings quite variable. In the spring brood commonly dull green, with indistinct lateral yellow stripes. In the fall brood the dorsum is pale yellow or flesh color, with two fine, indistinct, medio-dorsal lines of lilac color; subdorsal ridge pale, inclining to lilac on outer side. In subdorsal space are two nearly continuous, quite heavy, black or fuscous lines, separated by a broad pale stripe, from two narrow, interrupted dark lines, one beneath, the other above, the stigmata. On the thorax the dark stripes are represented by two slightly diverging dashes on each side. Situated in the subdorsal ridge, at the posterior edge of each segment, are a pair of small, geminate, piliferous warts, each bearing a sparse tuft of light sprangling hairs. The last larval skin, rolled into a little hairy ball, is often supported over the back of the chrysalis, raised above it on the hairs of the sub-dorsal ridges. The pupa is quite active and irritable, striking about in all directions when meddled with." (Murtfeldt.)

Pterophorus agraphodactylus.

Pterophorus agraphodactylus Walk., Cat. Lep. Het., Vol. XXX., p. 94 (1864).

Lioptilus agraphodactylus Wlsm., Pter. Cal. and Ore., p. 46, Plate III., fig. 6 (1880).

I have not seen this species, and therefore quote Lord Walsingham's description: —

"Head whitish in front, touched with brownish ochreous towards the thorax and in front; antennæ whitish, browner beneath; palpi very short. Thorax yellowish white.

"Fore wings remarkably narrow, dirty white, with a faint yellowish tinge, streaked longitudinally with faint slender lines of brownish gray, apparently following the neuration; the widest and most conspicuous of these runs parallel to the costa from the base of the wing to the middle of the anterior lobe, where it is diffused in a faint shade towards the costa, sending two slender and scarcely discernible lines to the apex and inner margin. There are two slender brownish-gray lines on the dorsal half of the wing, the upper one, coming from the base, passing below the cleft, where it throws off a branch beneath and running along the upper edge of the second lobe to its apex; the lower coming also from the base, and attaining the dorsal margin below the base of the cleft. The costa pale; the cilia tinged with gray. Hind wings and fringes pale cinereous. Abdomen and legs slightly yellowish white. Underside uniformly pale cinereous, except the costa and the fringes of the anterior lobe within the fissure which are whitish.

"Expanse, 25 mm."

Habitat. — St. Domingo, Southern Oregon. Early stages and food plant unknown.

Pterophorus inconditus.

Lioptilus inconditus Wlsm., Pter. Cal. and Ore., p. 44, Plate III., fig. 5 (1880).

Expanse of wings, 19 mm. Head pale brownish gray, paler between the antennæ; palpi brownish gray; antennæ pubescent, whitish, the basal segment enlarged and with a few erect scales on its inner side; thorax and abdomen slightly tinged with yellowish. Legs yellowish white.

Fore wings very pale brownish gray or bone color, without any markings except faint traces of darker lines upon some of the veins. Fringes slightly paler than the wings. Hind wings and fringes very slightly darker, with a more decided cinereous tinge.

Under side of all the wings brownish gray, with the costal margin of the fore wings slightly paler.

Habitat. — California, Washington, D. C. Early stages and food plant unknown.

PTEROPHORUS PARVUS.

Lioptilus ?parvus Wlsm., Pter. Cal. and Ore., p. 55, Plate III., fig. 12 (1880).

As I have no example of this species, I quote Lord Walsingham's description: —

"Head grayish white, a scarcely paler frontal tuft projecting slightly above the long, well clothed but sharply pointed palpi, which are about twice the length of the head; antennæ pubescent, grayish.

"Fore wings cleft to scarcely one-third of their length, with no posterior angle to the the upper lobe, which is rather narrow, acuminate and appressed at the apex, dusty grayish, sprinkled with fuscous scales, which form an elongate shade, extending from an ill-defined antemedian fuscous dot to the base of the anterior and to the apex of the posterior lobe; a small fuscous dot lies immediately before and slightly below the base of the fissure; there is a slight fuscous shade along the posterior margin of the upper lobe, of which the costal portion is rather pale ochreous; the costa itself whitish. The cilia along the apical margin of both lobes are grayish, spotted along their base with four or five groups of fuscous scales, of which one is at the extreme apex of the upper lobe. The anal angle appears to be slightly more defined in the second lobe of the fore wings, and the fissure rather wider at the base than is usual in this genus. Hind wings cinereous. Abdomen grayish white; the legs whitish, first two pairs touched at the sides with grayish fuscous. The first pair of spurs on the hinder tibiæ are unequal in length; the second pair equal to the longest of the other two.

"Expanse, 15 mm."

Habitat. — California. Early stages and food plant unknown.

PTEROPHORUS KELLICOTTII.

Lioptilus Kellicottii Fish, Can. Ent., Vol. XIII., p. 141 (1881).

Expanse of wings, 28–30 mm. Head ochreous brown, whitish between antennæ. Palpi rather long and slender, second segment with a small tuft of raised scales on the upper side at the extremity. Antennæ pale ochreous, brownish beneath; thorax and abdomen pale brownish ochreous, the latter striped longitudinally with pale

brown lines. Fore and middle legs brownish ochreous; hind legs whitish ochreous, tarsi paler.

Fore wings pale ochreous, dusted more or less with brownish scales, which in some examples form longitudinal streaks on the costa and basal half of the median space; a dark-brown dot on the base of fissure; two brown dashes on the costa near the apex, one on the hind margin of first lobe near the apex, usually four at the end of the second lobe on veins 2, 3, 4 and 5. Fringes concolorous. Hind wings, also under side of all the wings, cinereous brown, with a silky lustre. Fringes darker.

Habitat. — New York. Food, *Solidago.*

"The larva, when first examined, August 22, was .3 of an inch long; color light yellow, head and shield darker, the oblique anal plate almost black, bearing hairs and hooks; dorsal and subdorsal lines pinkish. By the middle of September it abandons the branches, being then .45 of an inch in length, and bores into the stalk a few inches above the ground; it makes its way down the pith into the roots, well under the ground, where it passes the winter. I fetched several examples from the fields in January for examination; they were then .58 to .6 of an inch in length, lighter in color, with the longitudinal lines of pink brighter than in autumn, the eighth segment conspicuously marked on the back by pink. There are few hairs over their smooth bodies; on the last ring, however, there is a brown or black chitinous disc, with a circle of long brown hairs about its circumference; in the centre of this disc there is a small papilla, with two stout, straight black teeth, pointing rearwards; these teeth are hooked upward in the autumn stage. The hairs render the plate sensitive to touch, and help to brush fragments from their long, narrow galleries, while the teeth assist in backward motion in them. The mature larvæ obtained in May differ but slightly from these, except that they are then .7 of an inch long, and the pink stripes and marks are brownish. The fourth, fifth and sixth segments are smaller than those preceding or following them. They are quite active, moving up and down their burrows rapidly.

"By the middle of May the caterpillar has worked its way back to the place of entrance in autumn, enlarging its way to accommodate its increased size, and, after loosely stopping the upper part with a few chips, retires and changes to the pupa. It is then .6 of an inch in length, slender, cylindrical. Color white, except the oblique disc or plate terminating the head, which is made dark by many teeth-like elevations on its surface. The abdominal segments are clothed with hairs, and the last four segments have each

a transverse row of teeth on the dorsal part, reminding one of a Tortrix or Cossus pupa. The conical tip of the abdomen has many teeth; these teeth, together with the roughness on the head, enable the pupa to worm its way up and down the burrow with readiness. When removed from the stem to the table, it travels about, rolling and worming its way very much as do the pupæ of certain stem-boring beetles. The wing and limb covers are free for a considerable distance from their tips." (Kellicott.)

Pterophorus grandis.

Lioptilus grandis Fish, Can. Ent., Vol. XIII., p. 141 (1881).

Expanse of wings, 34 mm. Head, palpi, antennæ, thorax and abdomen of nearly a uniform pale brownish-ochreous color. Legs brownish ochreous, with tarsi somewhat lighter.

Fore wings pale brownish ochreous, in some species with a few scattered faint brownish dots on the second lobe. Fringes slightly darker. Hind wings very slightly browner than fore wings, with the fringes still darker.

Habitat.—California. Early stages and food plant unknown.

Pterophorus monodactylus.

Alucita monodactyla Linn., Syst. Nat., Ed. X, Vol. I., p. 542 (1758).
Pterophorus cineridactylus Fitch, N. Y. Rep., Vol. I., p. 848 (1854).
Pterophorus nævosidactylus Fitch, N. Y. Rep., Vol. I., p. 849 (1854).
Pterophorus pergracilidactylus Pack., Ann. Lyc. N. Y., Vol. X., p. 265 (1873).
Pterophorus monodactylus Wlsm., Pter. Cal. and Ore., p. 39, Plate II., fig. 16; Plate III., fig. 1 (1880).

Expanse of wings, 22–26 mm. Head and thorax pale gray, sprinkled with brown scales. Palpi short, tipped with brown; antennæ grayish white, spotted with fuscous above. Abdomen grayish ochreous, striped with fuscous and brown scales on the sides; a dorsal row of brown dots, one at the base of each segment. Legs grayish, with the joints enlarged and covered with brownish hairs; a tuft of scales near the middle of the hind tarsi on the side opposite the spurs.

Fore wings varying from pale grayish to pale reddish brown, often mixed with white and sometimes with a few black scales; stripes or streaks of dark brown or blackish scales on the costa and hind margin; before the fissure a brown spot, sometimes tapering to a point toward the base; an elongated spot of brown

scales on the costa, half-way between the latter and the apex, with two smaller ones between it and the apex; one or more small blackish dots on one or both lobes near the apex. Fringes grayish, tinged with fuscous on the outer third of fissure. Hind wings gray or fuscous, with a silky lustre; fringes slightly darker.

This species is exceedingly variable both in color and markings, some examples being very light with but few spots, while others are reddish brown.

Habitat. — Europe; Maine to California. Food, *Convolvulus sepium*, *Convolvulus arvensis*, *Chenopodium album*, *Atriplex patula.*

"*Larva.* — Length, when at rest, about five-eighths of an inch, and stout in proportion. Head polished and rather small, narrower than the second segment. Body uniform and cylindrical, tapering a little posteriorly. Segmental divisions well defined and deeply cut ventrally; each tubercle emits a tuft of short but rather strong hairs. Ground color bright yellowish green, more decidedly green on the back; head pale yellow, the mandibles light brown. A fine but clear yellowish white line forms the dorsal stripe; there is a much broader stripe of the same color along the spiracular region, and the space between it and the spiracles is prickled with streaks and spots of the same color. Spiracles black, hairs grayish. Ventral surface, legs and prolegs uniformly pale green. The pupa, although attached by the tail, was laid flat along the top of the cage." (Porritt.)

Pterophorus cretidactylus.

Pterophorus cretidactylus Fitch, N. Y. Rep., Vol. I., p. 849 (1854).
Œdematophorus occidentalis Wlsm., Pter. Cal. and Ore., p 37, Plate II., figs. 13, 14 (1880).
Pterophorus cretidactylus Fern., Can. Ent., Vol. XXV., p. 96 (1893).

Expanse of wings, 26 mm. Head whitish ochreous, slightly tinged with fawn color on the front; palpi fawn color; antennæ whitish, faintly spotted with fawn color; thorax whitish ochreous. Abdomen fawn color. Fore and middle legs white, with dark, brush-like tufts on the joints; hind legs tinged with fawn color, whitish on the inner sides; segments slightly thickened, not annulated.

Fore wings whitish ochreous, the costa, apex and hind margin tinged with fawn color; a dark fawn-colored spot before the base of the fissure, more or less connected obliquely with an elongated spot of the same color on the costa; a light space on each side of

the costal spot. Fringes whitish ochreous, tinged with pale fawn color. Hind wings and fringes lustrous, pale fawn color.

Habitat. — New York, California. Early stages and food plant unknown.

Pterophorus eupatorii.

Œdematophorus cretidactylus Zell., Lep. Westk. Am., p. 22 (1874).
Œdematophorus cretidactylus Wlsm., Pter. Cal. and Ore., p. 35 (1880).
Œdematophorus cretidactylus Kell., Bull. Buf. Soc., Vol. IV., p. 2 (1882).
Alucita eupatorii Fern., Can. Ent., Vol. XXV., p. 96 (1893).

Expanse of wings, 22–24 mm. Head dull reddish brown; thorax pale brown; legs brown, darker at the middle and ends of the tibiæ; segments of the tarsi white at the base and brown at the tips; spurs white in the middle and brown at the tips.

Fore wings pale ochre yellow, whitest on the costal portion, and sprinkled with dark-brown scales to such an extent as to give them a wood-brown color. These dark-brown scales form an antefissural spot, which in some specimens is concave on the outside and extended obliquely up and out, nearly reaching a dark-brown costal streak over the end of the fissure, beyond which are two costal dark-brown spots, the first of which is the smaller. The brown on the second lobe sometimes gives this part of the wing a streaked appearance. Fringes smoke brown, cut with whitish once on the first lobe and twice on the outer margin of the hind lobe. Hind wings and fringes brownish cinereous.

Habitat. — New York, California, Vancouver Island. Food, *Eupatorium purpureum.*

"*Larva.* — Length, 0.55 of an inch; color of skin greenish, striped with wine color and white; hairs dusky, lighter laterally. Dorsal line white, interrupted with circles and bordered laterally with wine color. That part of the dorsal space in which the tubercles stand, much lighter in hue; subdorsal and stigmatal lines white, bounded by the same shade as the dorsal. Head light green, spiracles ringed with brown.

"*Pupa.* — Color, green, ornamented with wine-colored and white lines. It has the same size and habits as *homodactylus;* the tubercles are similar. It is a little thicker, the anterior end more obtusely truncated and less bilobed. The hairy clothing similar to *homodactylus*, but the hairs not so smooth as in that pupa." (Kellicott.)

PTEROPHORUS GUTTATUS.

Œdematophorus guttatus Wlsm., Pter. Cal. and Ore., p. 36, Plate II., fig. 12 (1880).

Expanse of wings, 25 mm. Head and palpi whitish, sprinkled with cinereous, the palpi fuscous at the sides; thorax and abdomen whitish cinereous. Hind legs white, with two slightly fuscous annulations.

Fore wings whitish cinereous, paler at the base, dusted with fuscous scales toward the costa and hind margin; a white spot, generally bordered on the inner edge by two fuscous scales, lies at the base of the fissure; another similar spot is sometimes indicated before the middle of the hind margin. Fringes of the outer margin and fissure cinereous fuscous, slightly interrupted with whitish. Hind wings pale cinereous. Fringes paler.

Habitat. — California. Early stages and food plant unknown.

PTEROPHORUS CINERACEUS.

Œdematophorus cineraceus Fish, Can. Ent., Vol. XIII., p 73 (1881).

Expanse of wings, 28 mm. Front of head dark grayish brown, vertex pale cinereous. Palpi grayish brown, ascending, third segment short. Antennæ cinereous, dotted above with dark brown. Abdomen cinereous, marked with reddish-brown scales. Legs brownish cinereous, sprinkled with dark-brown scales; a band on the middle and on the end of the middle tibiæ dark grayish brown, spurs tipped with dark brown; tarsi whitish cinereous, slightly brownish at extreme end of segments.

Fore wings cinereous, tinged with brownish, and very thinly sprinkled with dark-brown scales. These scales form a median spot before the base of the fissure, bordered on the outside with white. A longitudinal brown spot occurs on the costa opposite the base of the fissure, and two smaller ones toward the apex. Fringes brownish cinereous. Hind wings and fringes brownish cinereous.

Habitat. — Washington. Early stages and food plant unknown.

PTEROPHORUS BARONI.

Œdematophorus Baroni Fish, Can. Ent., Vol. XIII., p. 73 (1881).

Expanse of wings, 30 mm. Front of head brownish cinereous, vertex lighter. Palpi rather stout, third segment very short and blunt. Antennæ pale cinereous, dotted above with dark brown.

Thorax and abdomen pale brownish cinereous, the latter marked dorsally by a row of fine black dots on each segment beyond the third. Anterior and middle femora brownish cinereous, tibiæ grayish, tarsi whitish cinereous. Hind femora and tibiæ pale brownish cinereous, spurs short, tipped with black.

Fore wings brownish cinereous, ochreous on the inner margin and second lobe, the whole surface sprinkled with fine black scales. Fringes concolorous with the wings. Hind wings and fringes dark cinereous.

Habitat. — California. Early stages and food plant unknown.

Pterophorus gratiosus.

Œdematophorus gratiosus Fish, Can. Ent., Vol. XIII., p. 73 (1881).

Expanse of wings, 22 mm. Head and palpi dark brown; antennæ pale brownish, dotted above with white and dark-brown scales. Thorax grayish brown, anterior portion lighter. Abdomen fawn brown. Legs grayish brown, tarsi pale cinereous, slightly darker on the extremities of segments.

Fore wings pale cinereous, dusted with dark brown; an oblique brown spot occurs before the base of the fissure and a longitudinal brown costal line nearly opposite the base of fissure. Fringes concolorous with wings. Hind wings and fringes brownish cinereous, third feather whitish.

Habitat. — California. Early stages and food plant unknown.

Pterophorus lugubris.

Œdematophorus lugubris Fish, Can. Ent., Vol. XIII., p. 140 (1881).

Expanse of wings, 27–29 mm. Head and palpi dark smoky brown. Antennæ dotted above with white and blackish scales. Thorax light smoky brown. Abdomen slender, dark smoky brown, thickly sprinkled with very dark scales. Legs grayish brown, the middle tibiæ whitish just before the middle and end; all the tarsi whitish at base of joints; spurs whitish at base.

Fore wings dark smoky gray, dusted with dark brown scales; a longitudinal black dash on the costa, opposite the base of fissure; an obscure blackish spot before the base of fissure, bordered outwardly by gray scales. Faint indications of two smaller blackish spots on the costal margin of anterior lobe. Fringes smoky gray, with a few whitish hairs on the hind margin of anterior lobe near the apex. Hind wings and fringes, as well as under side of wings, cinereous.

Habitat. — California. Early stages and food plant unknown.

Pterophorus grisescens.

Œdematophorus grisescens Wlsm., Pter. Cal. and Ore., p. 34, Plate II., fig. 11 (1880).

Expanse of wings, 29 mm. Head and palpi gray, with a fuscous tinge on the apex of the palpi. Antennæ spotted with gray and fuscous. Thorax and abdomen grayish, sprinkled with fuscous. Legs grayish white, tinged on the segments and on the tips of the spurs with fuscous.

Fore wings gray, slightly spotted with white and dusted with fuscous scales, the hind portion touched with ferruginous. A white space on the costa before the base of the fissure, and another beyond and obliquely connected by whitish scales with the base of fissure; a whitish spot before the middle of the hind margin and an indistinct fuscous spot above it. Fringes mottled with white and grayish fuscous. Hind wings cinereous; fringes whitish mixed with gray.

Habitat. — Southern Oregon. Food, *Artemisia.*

Pterophorus inquinatus.

Œdematophorus inquinatus Zell., Beitr., p. 125 (1873).
Œdematophorus ambrosiæ Murtf., Am. Ent., Vol. III., p. 236 (1880).

Expanse of wings, 19 mm. Head and thorax gray, spotted with white; palpi small, porrect, acute, whitish, touched with brown outwardly. Antennæ whitish, spotted with brownish, white at the base on the under side. Abdomen gray.

Fore wings dust gray, thickly dusted with white and brown scales, forming scattered flecks or blotches, one of which is generally present on the middle of the space between the base of the wing and the fissure; a larger one before the fissure and separated from it by a whitish space, against which its oblique outer margin is excavated; below this is a longitudinal streak of scales, bordered basally by a white spot and separated from the spot before the fissure by a whitish space. Two blackish streaks or spots occur on the costa, the larger one above the base of fissure, the other half-way between it and the apex of the wing. Fringes grayish, cut with white under the apices of the lobes and on the anal angles, where there is a white wisp. A similar wisp before the apex and on the anal angle of the second lobe. A brown dot sometimes rests on the base of each of the three wisps. Hind

wings brownish gray, a diffuse brown dot on the apex of each feather or at least on the first. Fringes brighter.

Habitat.—Alabama, Texas, Missouri, Colorado, Arizona. Food, Rag-weed (*Ambrosia artemisiæfolia*).

"*Larva.*—Length, 0.35; diameter, 0.09. Form depressed. Color, pale greenish gray, with very characteristic dark markings and lateral tufts of long, white silken hairs. Head small, light brown, corneous, retractile. Segment 1 with a dilated, partially free shield-like collar, covering top and projecting over the head. The ornamentation of this collar consists of five central minute brown dots, with four still smaller black ones on each side, from each of which proceeds a short curving bristle. The projecting edges fringed with soft light hairs. Segments 2 and 3 gradually broadening backward, ornamented on dorsum with two oblong, pale, brown spots on either side of a triangle of very minute black dots, and having a larger black dot on each outer side. Two short bristles arise from each of the more conspicuous spots. Abdominal segments each with four somewhat elevated brown spots, from which proceed single, short, backward-curving bristles. Between the posterior pair of brown spots are two smaller black ones, each of which forms the base of a very short clubbed piliferous process, which turns backward, resting flat upon the surface.

"The stigmata are annulated with black, and obliquely above and forward of each are two small brown dots. The lateral tufts are below the stigmata, and each is composed of from seven to nine long hairs, which under the lens are remotely pectinate. A little above and back of each of these tufts is a semicircle of fine, scale-like bristles. The prolegs are very short.

"*Pupa.*—Length, 0.25. Swollen and blunt anteriorly. Color, pale fulvous, with a roseate hue on dorsum. Dorsal surface beset with tufts of dingy hairs, with a lateral fringe of single straight hairs, which serve to secure it more firmly to the mat of silk upon which it rests. Dorsum marked near the head with two large, dull-brown spots, and an indistinct longitudinal stripe of the same color on the abdomen. On either side of the thorax is a small, velvety dark-brown dot." (Murtfeldt.)

Genus STENOPTILIA Hüb., Verz., p. 430 (1826).

Vertex smooth; front cone shaped, smoothly scaled; palpi extending beyond the frontal projection, the second segment somewhat triangular, with projecting scales above at the end, the third

segment very small and cylindrical. Fore wings fissured about one-third of their length, the lobes narrow and with very oblique outer margins, but with more or less distinctly visible anal angles. The feathers of the hind wings are dissimilar in form: the first is the widest; the second is smaller, and has a long, produced apex; the third is linear, without dark scales in the hind fringe. The venation is complete, as shown on Plate III., figs. 1 and 2.

SYNOPSIS OF THE SPECIES.

1.	Expanse of wings less than 15 mm., ...	*pumilio.*
	Expanse of wings more than 15 mm., ...	2.
2.	With a dark-brown streak on the middle of first lobe, . .	3.
	Without a dark streak on the middle of first lobe, .	*pterodactyla.*
3.	Second lobe without any trace of a brown streak, .	*exclamationis.*
	Second lobe with a more or less complete brown streak,	*semicostata.*

STENOPTILIA PUMILIO.

Mimeseoptilus pumilio Zell., Beitr., p. 124 (1873).

Expanse of wings, 12 mm. Head reddish gray, front whitish; palpi very thin, filiform, horizontal, whitish. Antennæ pale gray, white towards the base on the outside. Thorax reddish gray. Abdomen yellowish white at the base and end. Legs slender, white, the first pair of spurs on hind tibiæ unusually long.

Fore wings unusually short and broad, very bright fawn color, darkest on the costal margin of the anterior lobe; costal vein white for two thirds of its length; a long blackish streak on the fold at the basal fourth of the wing; a long, conspicuous point in the middle between this and the fissure, and before these one or two long, confused flecks. Fringe of anterior lobe white or gray, with scattered black scales, with two black, somewhat commingled dots on the outer margin near the anal angle. Fringe of the second lobe gray, thickly sprinkled with deep black scales, which are united with three black spots on the hind margin; at the apex it is whitish, and marked with a row of unequal, somewhat commingled dots, which do not reach to the base of the fringe. Hind wings brownish gray, with much lighter fringes. On the apex of the first and second feathers a small black dot may be seen in certain lights, most distinct on the under side, where the apex of the third feather is dark brown.

Habitat. — Texas. Early stages and food plant unknown.

STENOPTILIA PTERODACTYLA.

Alucita pterodactyla Linn., Faun Suec., p. 371 (1761).

Expanse of wings, 21–24 mm. Head ashy brown; palpi long, acuminate, whitish at the tips; antennæ brownish above, whitish beneath. Thorax ashy brown, with a few darker scales. Abdomen fuscous, striped with pale ochreous lines and with a few dark-brown dots at the ends of the segments. Legs ochreous brown on the outside, whitish on the inner sides, tarsi very pale ochreous.

Fore wings reddish brown, the entire costa and the apex of the second lobe heavily sprinkled with dark-brown scales; a dark-brown reniform spot at the base of the fissure. Fringes ashy brown, with a very pale line at their bases. Hind wings fuscous with ashy brown fringes.

Habitat. — New York. Food, Speedwell (*Veronica chamædrys*).

"*Larva.* — Length, about five-eighths of an inch, and scarcely so stout as seems usual in the genus. Head small, and narrower than the second segment; it is polished, rather flat in front, but rounded at the sides. Body cylindrical, of fairly uniform width, but tapering a little at the extremities; segmental divisions well defined; the skin, with a soft and half-transparent appearance, is sparingly clothed with short hairs. There are two varieties, which are perhaps about equally numerous. In one of them the ground color is a bright grass green; in the other it is equally yellow green; in both forms the head is pale yellowish brown, very prettily reticulated with intense black. The dark-green, or, in some of the specimens, dark-brown alimentary canal forms the dorsal stripe; subdorsal lines rather indistinct, grayish white; below there is a still more indistinct waved line of the same color; there is, again, a similarly colored faint line along the spiracular region, and the segmental divisions are also of this pale color. In some specimens the hairs are gray; in others, brown. Ventral surface uniformly of the same color as the ground of the dorsal area; the legs reticulated and the prolegs tipped with black.

"*Pupa.* — The pupa is attached by the tail only, is rather long, but slender. The head, which is the thickest part, is abruptly rounded, and has the snout very prominent; thorax and abdomen rounded above, rather flattened beneath, and attenuated strongly to the anal point; eye, leg and wing cases fairly prominent, the last prolonged a considerable distance over the abdominal segments." (Porritt.)

STENOPTILIA EXCLAMATIONIS.

Mimeseoptilus exclamationis Wlsm., Pter. Cal. and Ore., p. 32, Plate III., fig. 10 (1880).

Expanse of wings, 22 mm. Head and palpi above, gray, with brown scales on the sides and beneath the palpi; thorax gray, with a brown spot on the top. Antennæ brownish gray. Abdomen ochreous brown. Legs brownish above, whitish beneath; feet white.

Fore wings gray, sprinkled with fuscous; costa fuscous; a row of fuscous spots runs from the base along under the cell for one-third the length of the wing; a small fuscous dash under the costa before the middle. Two fuscous spots before the end of the fissure, and beyond them, on the first lobe, a fuscous dash, pointing toward the upper spot, both together forming an exclamation point; above, the costa is spotted with fuscous. Fringes around the fissure white; along the outer margin cinereous, with a fuscous line at their base, but interrupted with white on the middle of the anterior and at the upper angle of the posterior lobe. Hind wings fuscous, with brownish scales. Fringes brownish.

Habitat. — California, Oregon. Early stages and food plant unknown.

STENOPTILIA SEMICOSTATA.

Mimeseoptilus semicostatus Zell., Beitr., p. 123 (1873).

Expanse of wings, 18 mm. Head grayish, with a fine white line above the eyes. Antennæ grayish, white toward the base. Thorax dusted with brown in front, whitish behind. Abdomen slender, pale yellowish, with two black dots on the end of each of the three segments before the last. Legs whitish.

Fore wings brownish gray, shading into pale reddish ochre along the hind margin and upon both lobes. In the middle of the space, between the base and the fissure, is a black dot. At the fissure, at the beginning of the second lobe, is a similar dot, and above it, in one example, is a larger but very distinct wisp-like mark. One example has in the middle of each lobe a fine, brown longitudinal streak; upon the first lobe it is short and in the middle, upon the second it is long and reaches quite to the hind margin. Fringes of hind margin of first lobe whitish at the base, gray outwardly; fringe of outer margin pure white with two black dots, one behind the other. Fringes of second lobe gray, dark outwardly except at the apex, where they are white with two black dots. Hind wings

brownish gray; fringes dark gray, with a clear fine line at their base and around the apex of the first two feathers.

Habitat. — Texas. Early stages and food plant unknown.

ORNEODIDÆ.

This family is not so closely related to the Pterophoridæ as was supposed by the early entomologists, and is introduced here merely because there is only a single species known in this country; and, as it is placed near the Pterophoridæ in collections, generally, it may be convenient to treat of it here.

Mr. Meyrick has given the following characters: —

Ocelli distinct. Tongue developed. Maxillary palpi obsolete. Fore wings six-cleft, cell very short, vein 5 absent, 7 separate, 8 and 9 coincident. Hind wings six-cleft, cell very short, 5 absent, 7 out of 6 near origin, 8 free.

GENUS ORNEODES Latr., Prec. d. Car., p. 148 (1796).

Labial palpi long, obliquely ascending, second segment tufted, third segment long and slim. Veins 5, 6, 9 and 10 wanting in the fore wings.

The following well-known European species occurs in the western part of this country: —

ORNEODES HEXADACTYLA.

Alucita hexadactyla Linn., Syst. Nat., Ed. XII., Vol. II., p. 542 (1758).

Alucita montana Ckll., MS., Ent. Mon. Mag., Vol. XXV., p. 213 (1889).

Expanse of wings, 13–16 mm. Head and thorax dark gray on the outside, whitish beneath and within.

Fore wings ochreous gray, with two dark-gray bands edged with whitish crossing them; the first on the middle of the wing and wider on the costa, where it is interrupted in the middle by a white-edged gray spot; the second is subterminal, and wider on the middle of the wing. A dark spot on the costa between the bands, and two others before the first band. A dark-brown or black dot on the apex of each of the feathers of both wings; feathers of the hind wings whitish and dotted with dark gray.

Habitat. — Europe; Missouri, California, Oregon, Canada, Manitoba. Food, *Lonicera*.

The eggs are laid in the early spring, on the flower-buds of the honey-suckle, and the larvæ, when hatched, feed inside of the buds and flowers.

Explanation of Plate I.

EXTERNAL ANATOMY OF PTEROPHORUS MONODACTYLUS.

[All the drawings enlarged.]

Fig. 1. Side view of denuded body of male.

Fig. 2. Top view of denuded body of male.

Fig. 3. Top view of head.

Fig. 4. Front view of head.

Fig. 5. Labial palpus.

Fig. 6. Base of tongue and labrum.

Fig. 7. Antenna of male.

Fig. 8. Fore leg.

Fig. 9. Tibial epiphysis.

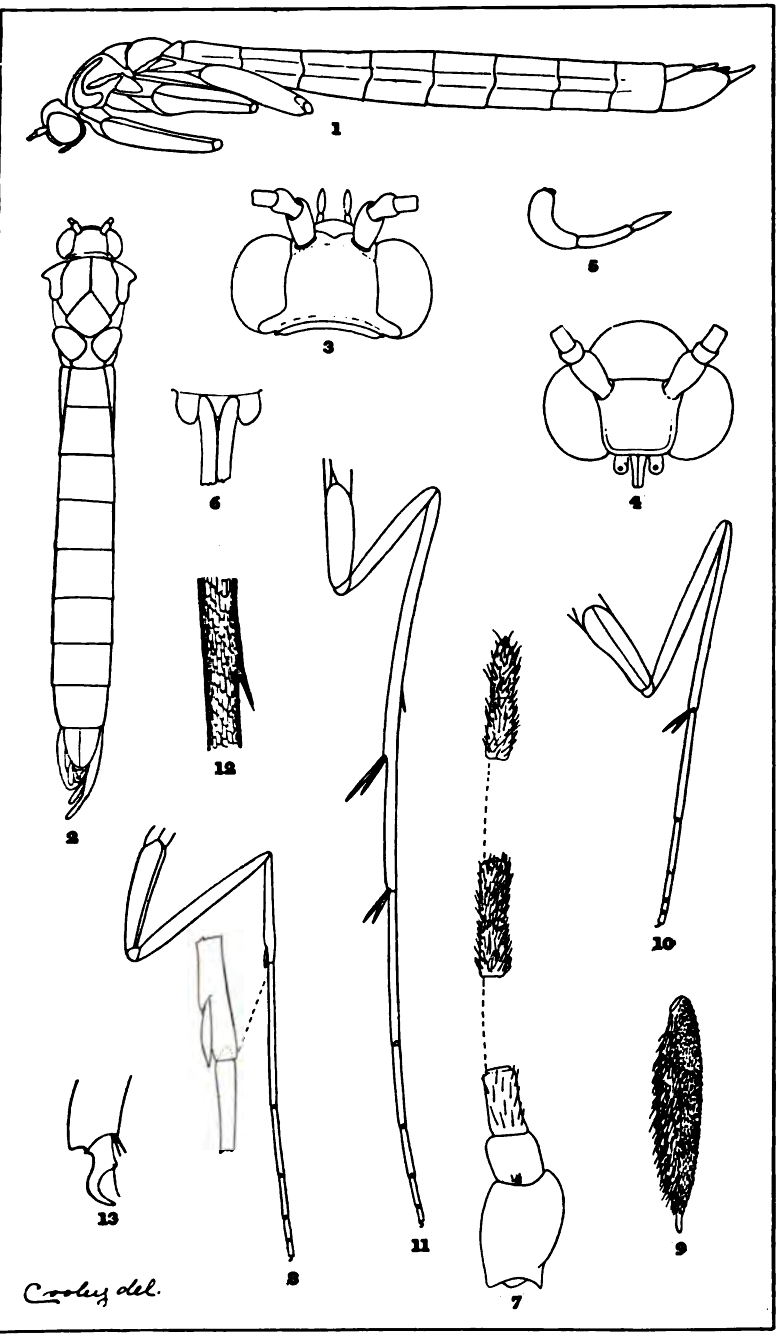
Fig. 10. Middle leg.

Fig. 11. Hind leg.

Fig. 12. Portion of hind tibia, showing tuft of scales.

Fig. 13. Claw from the hind leg.

Plate I.



Explanation of Plate II.

Fig. 1. Fore wing of **Platyptilia carduidactyla**, showing veins numbered. *A*, apex of first lobe; *B*, anal angle of first lobe; *C*, apex of second lobe; *D*, anal angle of second lobe.

Fig. 2. Hind wing of **Platyptilia carduidactyla**, showing veins numbered.

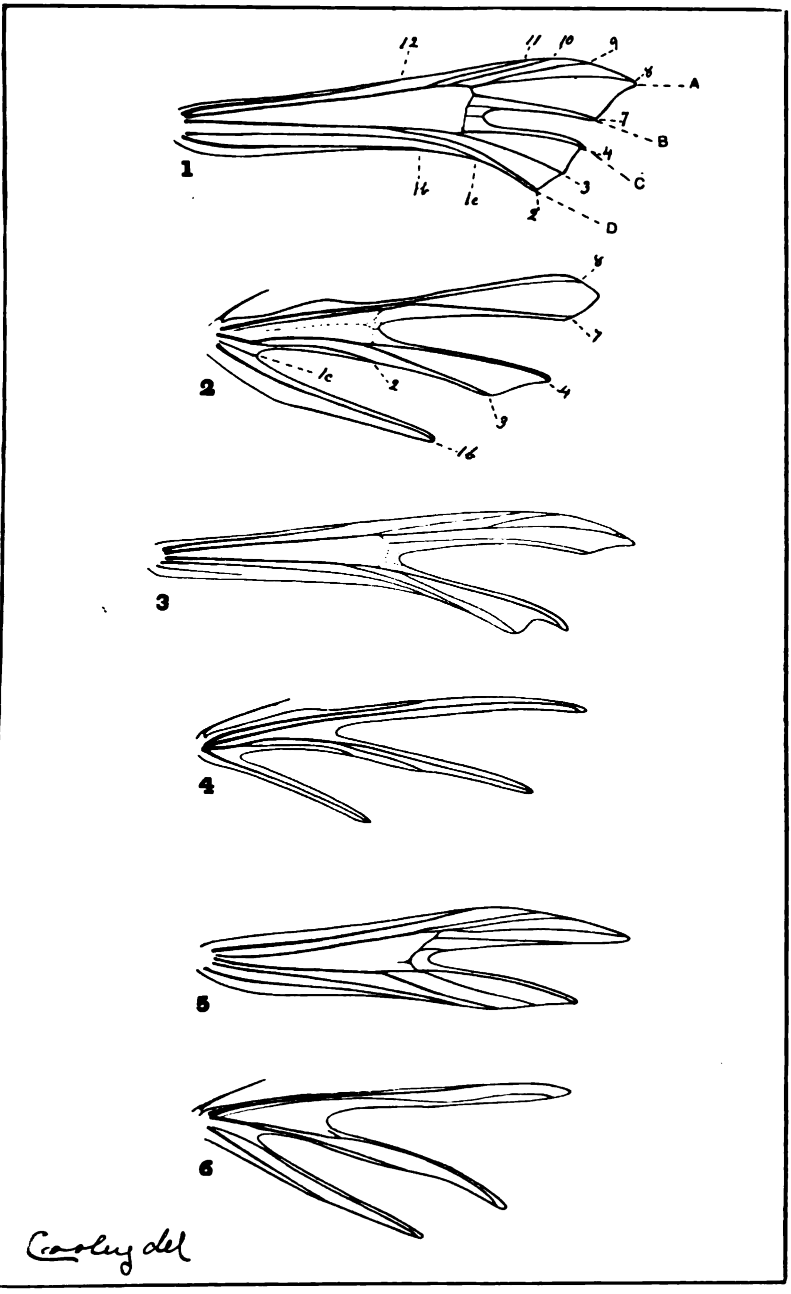
Fig. 3. Fore wing of **Oxyptilus periscelidactylus**.

Fig. 4. Hind wing of **Oxyptilus periscelidactylus**.

Fig. 5. Fore wing of **Alucita cinerascens**.

Fig. 6. Hind wing of **Alucita cinerascens**.

Plate II.



Explanation of Plate III.

Fig. 1. Fore wing of **Stenoptilia exclamationis.**

Fig. 2. Hind wing of **Stenoptilia exclamationis.**

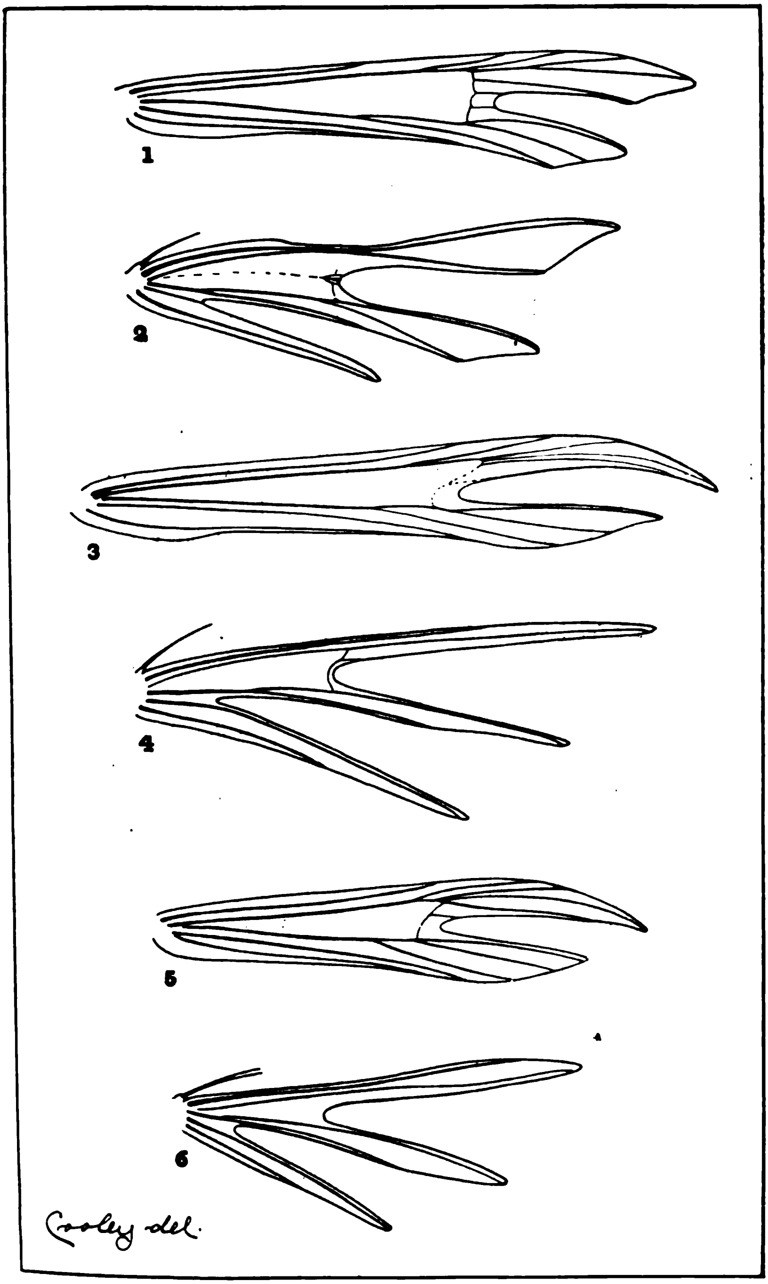
Fig. 3. Fore wing of **Pterophorus monodactylus.**

Fig. 4. Hind wing of **Pterophorus monodactylus.**

Fig. 5. Fore wing of **Pterophorus inquinatus.**

Fig. 6. Hind wing of **Pterophorus inquinatus.**

Plate III.



Explanation of Plate IV.

Male Genitalia of Pterophoridæ.

[Parts of the genitalia: *A*, dorsal plate; *B*, uncus; *C*, clasp; *D*, ventral plate; *E*, elongated internal chitinous appendage.]

Fig. 1. **Pterophorus homodactylus**, side view.

Fig. 2. **Pterophorus homodactylus**, top view.

Fig. 3. **Pterophorus inquinatus**, side view.

Fig. 4. **Pterophorus inquinatus**, top view.

Fig. 5. **Pterophorus kellicottii**, view of inside of left clasper.

Fig. 6. **Pterophorus kellicottii**, top view.

Fig. 7. **Pterophorus stramineus**, side view.

Fig. 8. **Pterophorus stramineus**, outside of left clasper.

Fig. 9. **Pterophorus subochraceus**, side view.

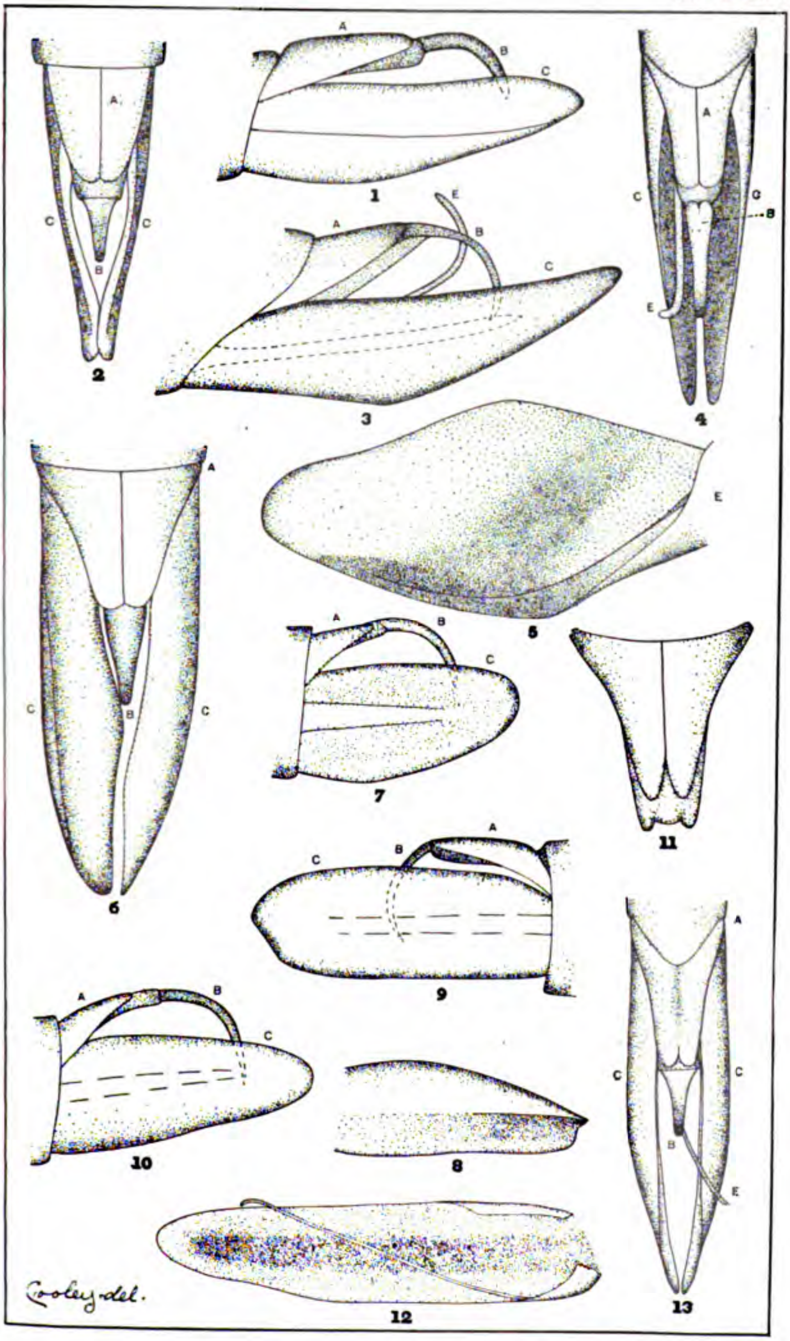
Fig. 10. **Pterophorus sulphureodactylus**, side view.

Fig. 11. **Pterophorus sulphureodactylus**, dorsal plate.

Fig. 12. **Pterophorus lugubris**, view of inside of left clasper.

Fig. 13. **Pterophorus lugubris**, top view.

Plate IV.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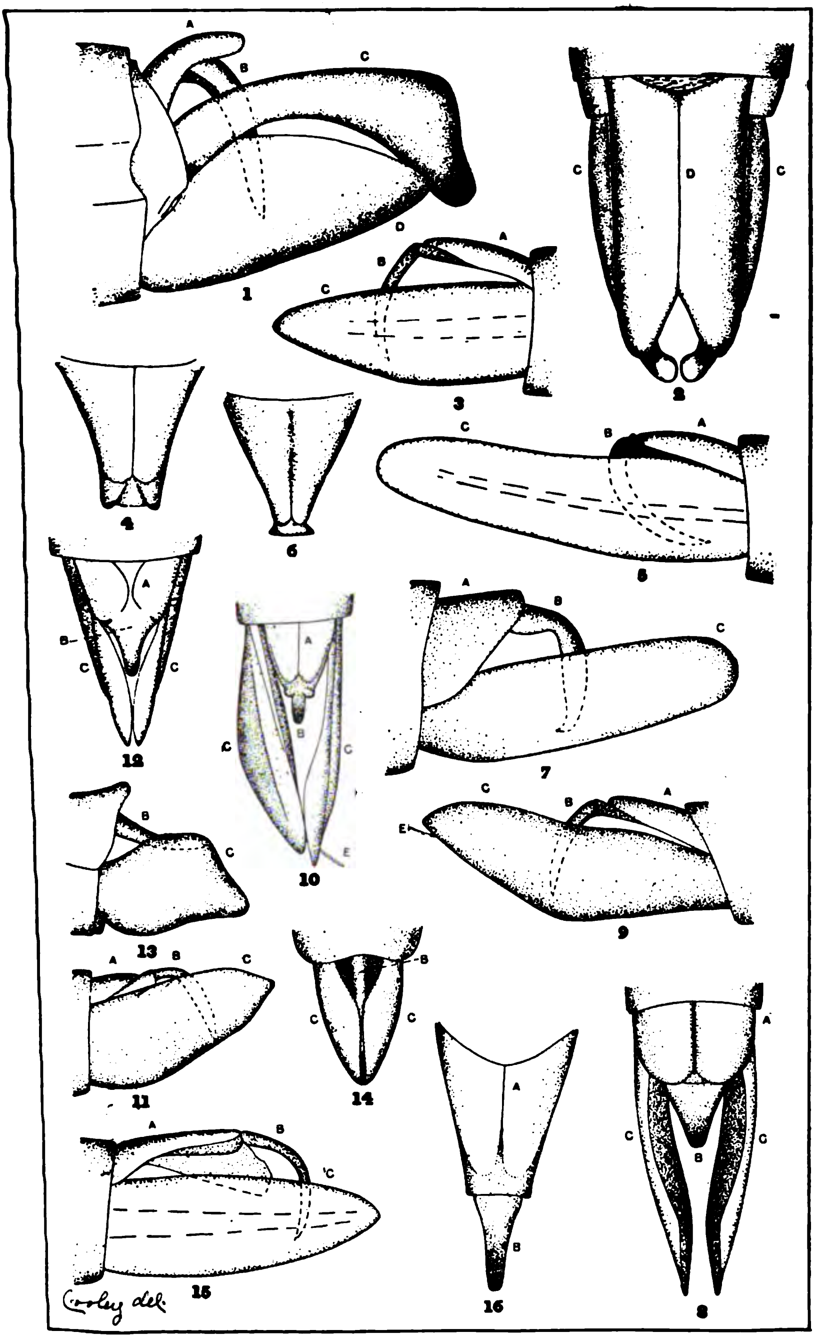
Explanation of Plate V.

MALE GENITALIA OF PTEROPHORIDÆ

Fig. 1. **Oxyptilus periscelidactylus**, side view.
Fig. 2. **Oxyptilus periscelidactylus**, view from beneath.
Fig. 3. **Pterophorus sulphureodactylus**, side view.
Fig. 4. **Pterophorus sulphureodactylus**, top view of dorsal plate.
Fig. 5. **Pterophorus cineraceus**, side view.
Fig. 6. **Pterophorus cineraceus**, top view of dorsal plate.
Fig. 7. **Platyptilia adusta**, side view.
Fig. 8. **Platyptilia adusta**, top view.
Fig. 9. **Pterophorus grandis**, side view.
Fig. 10. **Pterophorus grandis**, top view.
Fig. 11. **Alucita montana**, side view.
Fig. 12. **Alucita montana**, top view.
Fig. 13. **Trichoptilus ochrodactylus**, side view.
Fig. 14. **Trichoptilus ochrodactylus**, top view.
Fig. 15. **Pterophorus eupatorii**, side view.
Fig. 16. **Pterophorus eupatorii**, top view of dorsal plate and uncus.

Plate V.



Explanation of Plate VI.

MALE GENITALIA OF PTEROPHORIDÆ.

Fig. 1. **Oxyptilus ningoris**, side view.

Fig. 2. **Oxyptilus ningoris**, top view.

Fig. 3. **Oxyptilus ningoris**, view from beneath.

Fig. 4. **Oxyptilus tenuidactylus**, side view.

Fig. 5. **Oxyptilus tenuidactylus**, top view.

Fig. 6. **Oxyptilus tenuidactylus**, view from beneath.

Fig. 7. **Oxyptilus delawaricus**, side view.

Fig. 8. **Oxyptilus delawaricus**, top view.

Fig. 9. **Pterophorus cretidactylus**, side view.

Fig. 10. **Pterophorus cretidactylus**, top view of dorsal plate and uncus.

Fig. 11. **Orneodes hexadactyla**, side view.

Fig. 12. **Orneodes hexadactyla**, top view.

Fig. 13. **Orneodes hexadactyla**, view from beneath.

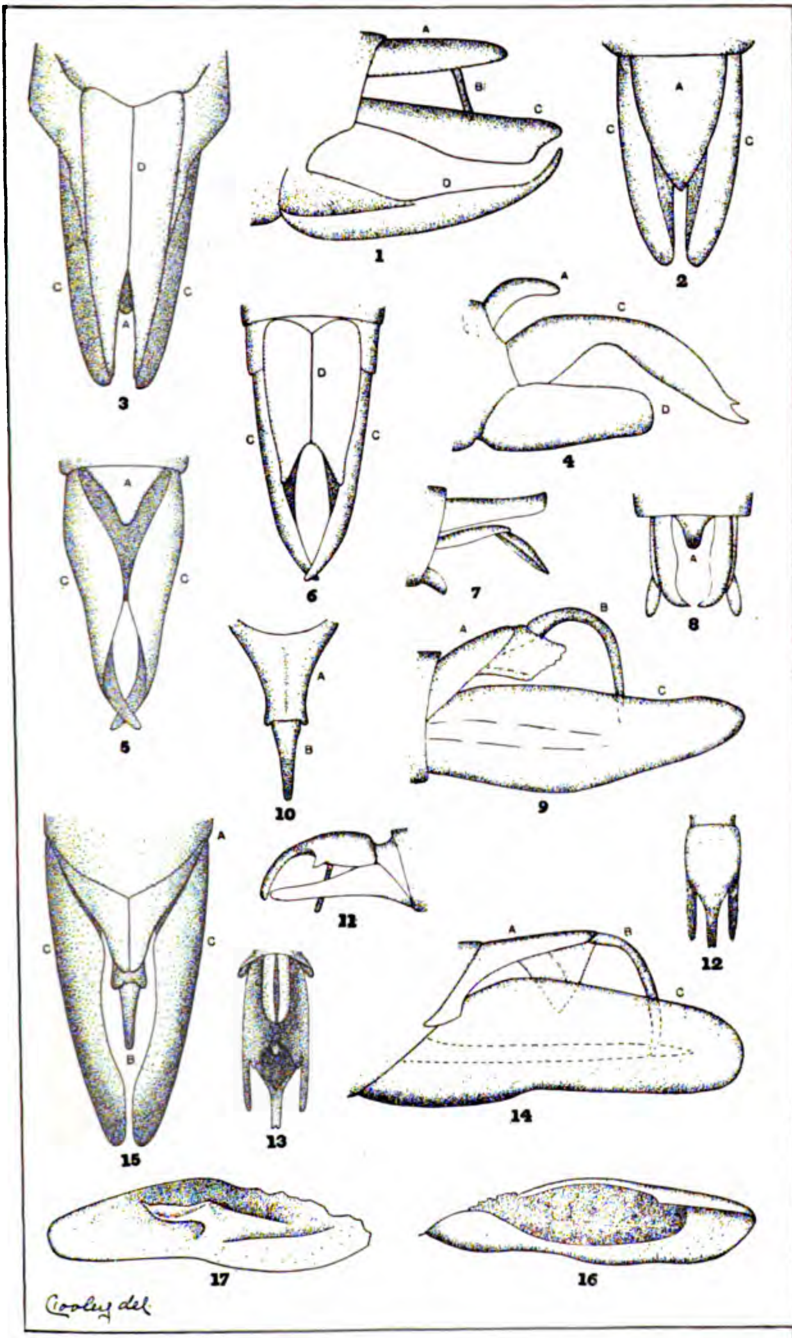
Fig. 14. **Pterophorus ambrosiæ**, side view.

Fig. 15. **Pterophorus ambrosiæ**, top view.

Fig. 16. **Pterophorus ambrosiæ**, view of inside of right clasper.

Fig. 17. **Pterophorus ambrosiæ**, view of inside of left clasper.

Plate VI.



Explanation of Plate VII.

GENITALIA OF PTEROPHORIDÆ.

Fig. 1. **Pterophorus monodactylus**, side view.

Fig. 2. **Pterophorus monodactylus**, top view.

Fig. 3. **Pterophorus monodactylus**, inside view of right clasper.

Fig. 4. **Pterophorus monodactylus**, inside view of left clasper.

Fig. 5. **Pterophorus monodactylus**, female.

Fig. 6. **Platyptilia edwardsii**, side view.

Fig. 7. **Platyptilia edwardsii**, top view.

Fig. 8. **Platyptilia carduidactyla**, side view.

Fig. 9. **Platyptilia carduidactyla**, top view.

Fig. 10. **Platyptilia carduidactyla**, view of inside of left clasper.

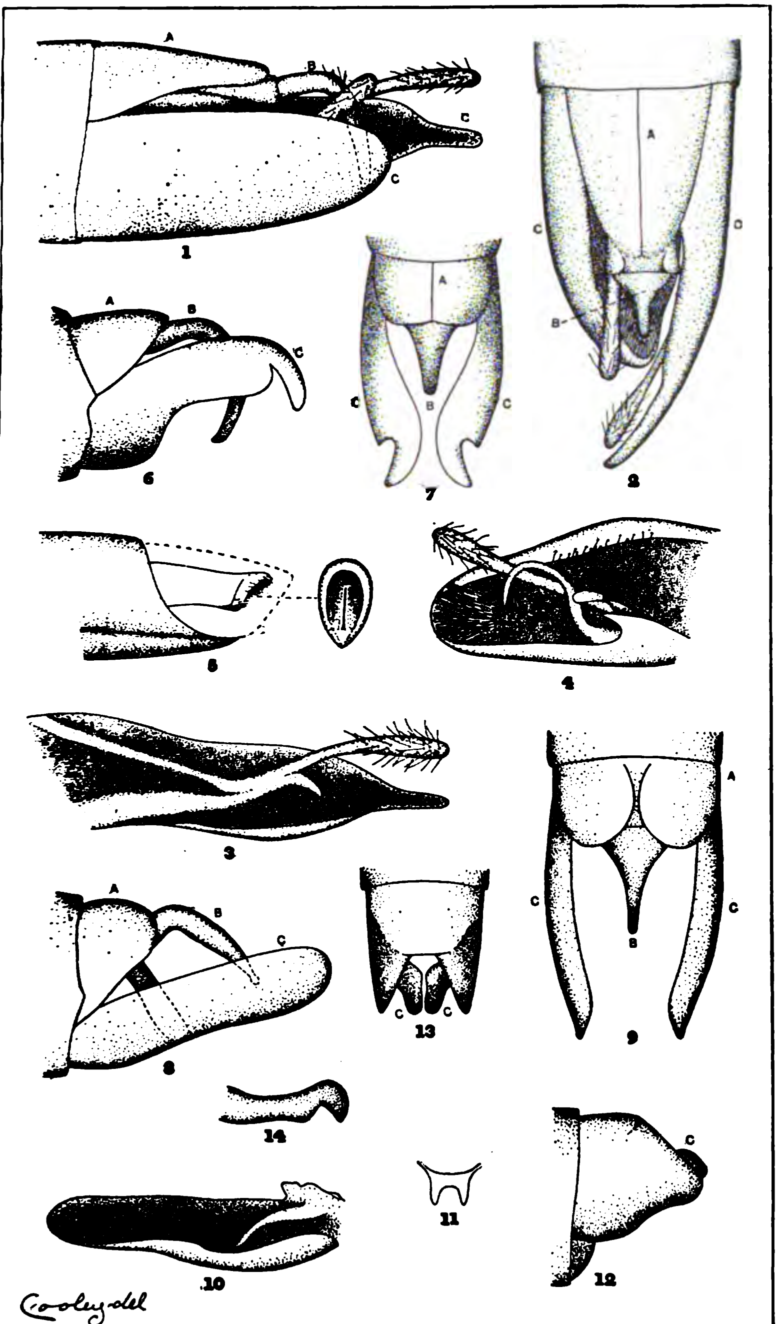
Fig. 11. **Platyptilia carduidactyla**, ventral plate.

Fig. 12. **Trichoptilus lobidactylus**, side view.

Fig. 13. **Trichoptilus lobidactylus**, top view.

Fig. 14. **Trichoptilus lobidactylus**, outside view of left clasper.

Plate VII.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Explanation of Plate VIII.

MALE GENITALIA OF PTEROPHORIDÆ.

Fig. 1. **Pterophorus elliottii**, side view.
Fig. 2. **Pterophorus elliottii**, top view.
Fig. 3. **Stenoptilia exclamationis**, side view.*
Fig. 4. **Stenoptilia exclamationis**, top view.*
Fig. 5. **Platyptilia albidorsella**, side view.
Fig. 6. **Platyptilia albidorsella**, top view.
Fig. 7. **Platyptilia albidorsella**, end view of uncus.
Fig. 8. **Platyptilia tesseradactyla**, side view.
Fig. 9. **Platyptilia tesseradactyla**, top view.
Fig. 10. **Platyptilia albida**, side view.
Fig. 11. **Platyptilia albida**, top view.
Fig. 12. **Platyptilia albicans**, side view.
Fig. 13. **Platyptilia albicans**, top view.
Fig. 14. **Platyptilia percnodactyla**, side view.
Fig. 15. **Platyptilia percnodactyla**, top view.

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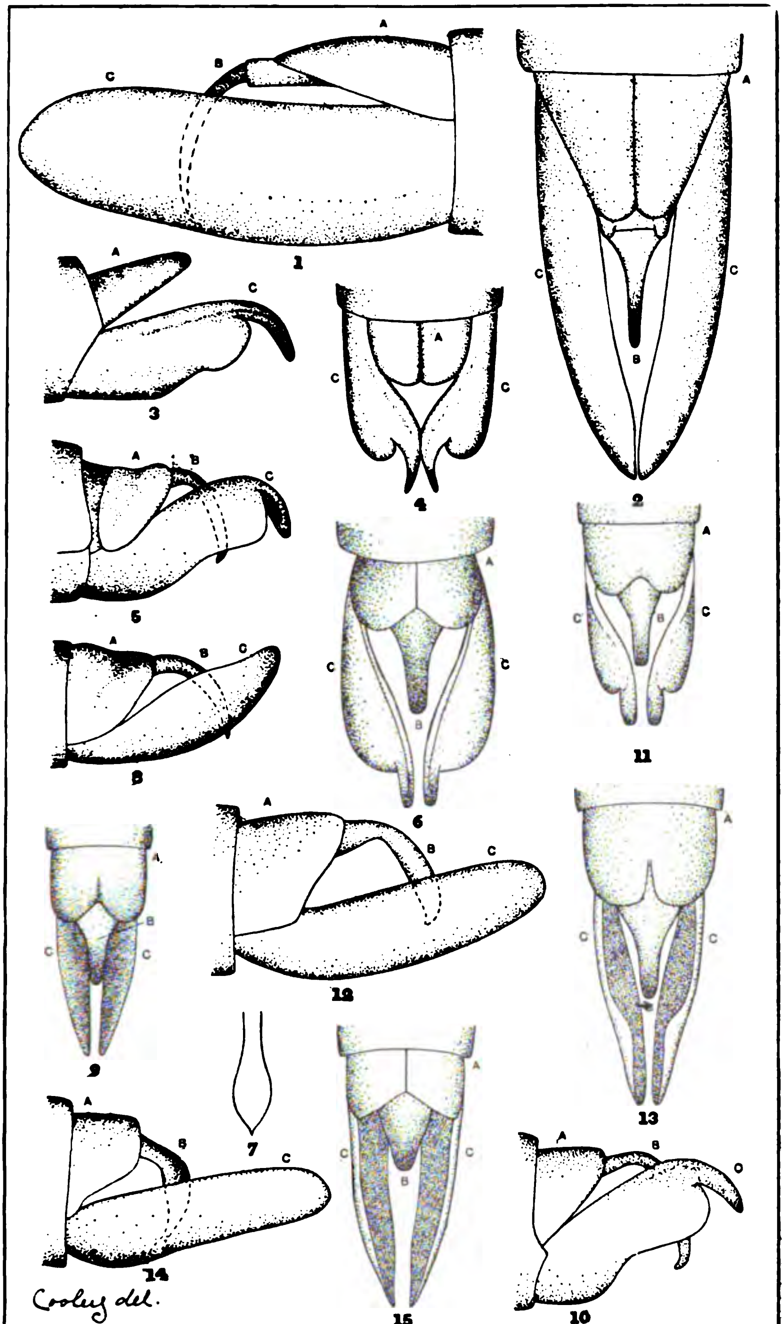
* The uncus is wanting in the specimens from which these drawings were made.

Plate VIII.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Explanation of Plate IX.

MALE GENITALIA OF PTEROPHORIDÆ.

Fig. 1. **Platyptilia cosmodactyla,** side view.

Fig. 2. **Platyptilia cosmodactyla,** top view.

Fig. 3. **Platyptilia cosmodactyla,** end of uncus.

Fig. 4. **Platyptilia marginidactyla,** side view.

Fig. 5. **Platyptilia marginidactyla,** top view.

Fig. 6. **Platyptilia albiciliata,** side view.

Fig. 7. **Platyptilia albiciliata,** top view.

Fig. 8. **Platyptilia albiciliata,** end of uncus.

Fig. 9. **Alucita cinerascens,** side view.

Fig 10. **Alucita cinerascens,** top view.

Fig. 11. **Alucita cinerascens,** view of an internal chitinous piece.

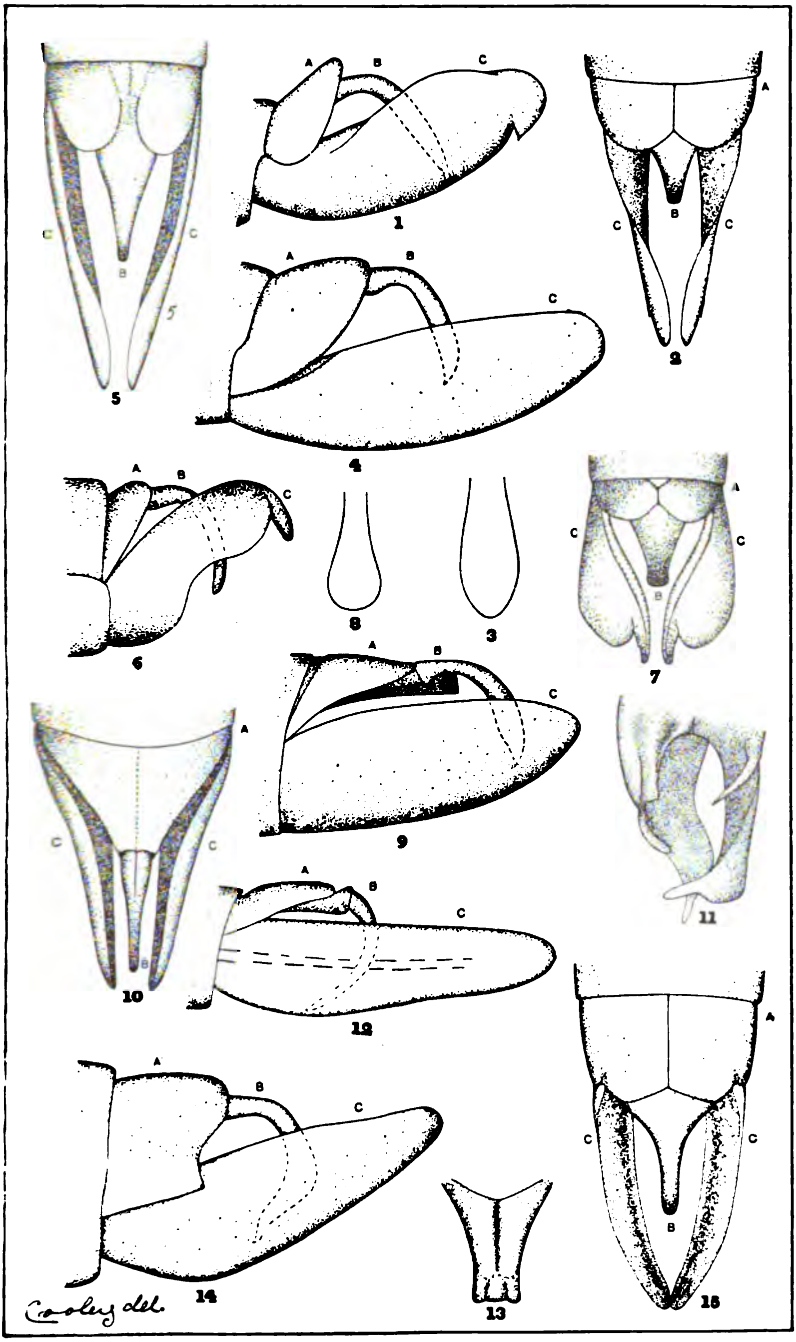
Fig. 12. **Pterophorus guttatus,** side view.

Fig. 13. **Pterophorus guttatus,** top view of dorsal plate.

Fig. 14. **Platyptilia ochrodactyla,** side view.

Fig. 15. **Platyptilia ochrodactyla,** top view.

Plate IX.



INDEX OF GENERA.

INDEX OF SPECIES.

TENTH ANNUAL REPORT

OF THE

HATCH EXPERIMENT STATION

OF THE

MASSACHUSETTS AGRICULTURAL COLLEGE.

JANUARY, 1898.

HATCH EXPERIMENT STATION

OF THE

MASSACHUSETTS AGRICULTURAL COLLEGE,

AMHERST, MASS.

By act of the General Court, the Hatch Experiment Station and the State Experiment Station have been consolidated under the name of the Hatch Experiment Station of the Massachusetts Agricultural College. Several new divisions have been created and the scope of others has been enlarged. To the horticultural has been added the duty of testing varieties of vegetables and seeds. The chemical has been divided, and a new division, "Foods and Feeding," has been established. The botanical, including plant physiology and disease, has been restored after temporary suspension.

The officers are: —

Henry H. Goodell, LL.D.,	*Director*.
William P. Brooks, Ph.D.,	*Agriculturist*.
George E. Stone, Ph.D.,	*Botanist*.
Charles A. Goessmann, Ph.D., LL.D.,	*Chemist* (fertilizers).
Joseph B. Lindsey, Ph.D.,	*Chemist* (foods and feeding).
Charles H. Fernald, Ph.D.,	*Entomologist*.
Samuel T. Maynard, B.Sc.,	*Horticulturist*.
J. E. Ostrander, C.E.,	*Meteorologist*.
Henry M. Thomson, B.Sc.,	*Assistant Agriculturist*.
Ralph E. Smith, B.Sc.,	*Assistant Botanist*.
Henri D. Haskins, B.Sc.,	*Assistant Chemist* (fertilizers).
Charles I. Goessmann, B.Sc.,	*Assistant Chemist* (fertilizers).
George D. Leavens, B.Sc.,	*Assistant Chemist* (fertilizers).
Edward B. Holland, B.Sc.,	*Assistant Chemist* (foods and feeding).
Fred W. Mossman, B.Sc.,	*Assistant Chemist* (foods and feeding).
Benjamin K. Jones, B.Sc.,	*Assistant in Foods and Feeding*.
Robert A. Cooley, B. Sc.,	*Assistant Entomologist*.
G. A. Drew, B. Sc.,	*Assistant Horticulturist*.
H. D. Hemenway, B.Sc.,	*Assistant Horticulturist*.
H. H. Roper, B.Sc.,	*Assistant in Foods and Feeding*.
A. C. Monahan,	*Observer*.

The co-operation and assistance of farmers, fruit growers, horticulturists and all interested, directly or indirectly, in agriculture, are earnestly requested. Communications may be addressed to the "Hatch Experiment Station, Amherst, Mass."

The following bulletins are still in stock and can be furnished on demand: —

No. 27. Tuberculosis in college herd; tuberculin in diagnosis; bovine rabies; poisoning by nitrate of soda.
No. 28. Canker, army and corn worms; red-humped apple-tree caterpillar; antiopa butterfly; currant stem girdler; imported elm-bark louse; greenhouse orthezia.
No. 29. Fungicides and insecticides; new spraying pump; spraying calendar.
No. 33. Glossary of fodder terms.
No. 35. Agricultural value of bone meal.
No. 36. Imported elm-leaf beetle; maple pseudococcus; abbot sphinx; San José scale.
No. 37. Report on fruits, insecticides and fungicides.
No. 38. Fertilizer analyses; composition of Paris green; action of muriate of potash on the lime resources of the soil.
No. 41. On the use of tuberculin (translated from Dr. Bang).
No. 42. Fertilizer analyses; fertilizer laws.
No. 43. Effects of electricity on germination of seeds.
No. 44. Variety tests of fruits; tests of vegetable seeds.
No. 45. Commercial fertilizers; fertilizer analyses; fertilizer laws.
No. 46. Habits, food and economic value of the American toad.
No. 47. Field experiments with tobacco.
No. 48. Fertilizer analyses.
No. 49. Fertilizer analyses.
Special bulletin, — The brown-tail moth.
Index, 1888–95.

Of the other bulletins, a few copies remain, which can only be supplied to complete sets for libraries.

The work during the year has been unusually diversified in its character and importance, a result of the numerous problems sent in for solution. In the agricultural division, soil tests with corn and potatoes grown in several localities have been continued; a comparison of different fertilizers

has been made; "Nitragin" has again been tried, with negative results; and an interesting test has been carried on of twenty varieties of corn, eighty-one of potatoes, sixty of grasses, twenty-one of millets and four of clover.

In the division of chemistry (fertilizers), aside from the six hundred analyses of licensed fertilizers and manurial substances, valuable work has been done for the tobacco-growers of the Connecticut valley in the analyses of tobacco leaves grown with different fertilizers, testing of the quality of ash and burning quality, and suggestions as to methods of planting, fertilizers to be employed and mechanical preparation of the soil.

In the botanical division, investigations have been carried on of the brown rot of stone fruit, the chrysanthemum rust, the leaf blights of certain native trees, as the sycamore, butternut, chestnut and black cherry, with recommendations of treatment for the brown rot and chrysanthemum rust.

The horticultural division has continued its work of testing varieties of fruit and seeds of vegetables, and has entered upon an investigation of the use of hydrocyanic acid as an insecticide.

From the entomological division have issued two important bulletins on the habits, food and economic value of the American toad and the brown-tail moth. A monograph on the plume-moths (some varieties of which attack plants of economic value and those raised for ornamental purposes) has been completed. The superiority of spraying for the canker worm over ink bands and oil troughs has been demonstrated, and investigations carried on of new insecticides with which to assail the gypsy moth.

A series of observations for the electrical determination of moisture in the soil, in connection with the growth of corn, were undertaken by the meteorological division. Owing to breaks in the circuit and other causes that made the instrument fail to work, and the abnormally wet weather of the summer, the results were not entirely satisfactory, and the observations will be repeated the coming season.

Three investigations in the division of foods and feeding are worthy of special note: (*a*) On the comparative values

of corn meal and hominy and cerealine feeds for pork production, when fed in combination with skim-milk. It was found that the pigs did quite as well on these feeds as on an equal amount of corn meal. (*b*) On salt-marsh hay. It was found to possess less feeding value than English hay, but, combined with grain and ensilage, produced nearly as much milk and butter as an equal amount of English hay thus combined. (*c*) On cotton-seed feed as a hay substitute for milch cows. More energy was used up in its digestion than in hay, and it was concluded that Massachusetts farmers would derive no benefit from feeding this material in place of hay.

Reports of the different divisions, giving in detail the work of the year, accompany this brief summary.

ANNUAL REPORT

OF GEORGE F. MILLS, *Treasurer* OF THE HATCH EXPERIMENT STATION OF MASSACHUSETTS AGRICULTURAL COLLEGE,

For the Year ending June 30, 1897.

Cash received from United States treasurer,		$15,000 00
Cash paid for salaries,	$5,087 75	
for labor,	3,312 26	
for publications,	2,354 06	
for postage and stationery,	264 11	
for freight and express,	245 78	
for heat, light and water,	193 31	
for seeds, plants and sundry supplies,	600 55	
for feeding stuffs,	185 11	
for library,	1,139 85	
for tools, implements and machinery,	272 21	
for furniture and fixtures,	33 43	
for scientific apparatus,	226 83	
for live stock,	125 45	
for travelling expenses,	352 32	
for contingent expenses,	42 73	
for building and repairs,	564 25	
		$15,000 00

Cash on hand July 1, 1896,	$1,042 92	
Received from State treasurer,	10,000 00	
from fertilizer fees,	4,087 75	
from farm products,	1,934 15	
from miscellaneous sources,	1,022 19	
		$18,087 01
Cash paid for salaries,	$10,784 83	
for labor,	1,075 81	
for publications,	175 03	
for postage and stationery,	156 18	
for freight and express,	187 48	
for heat, light and water,	361 64	
Amount carried forward,	$12,740 97	

Amount brought forward, ...	$12,740 97	
Cash paid for chemical supplies, ...	592 48	
for seeds, plants and sundry supplies, .	515 54	
for fertilizers, ...	1,074 41	
for feeding stuffs, ...	559 24	
for library, ...	61 82	
for tools, implements and machinery, .	28 62	
for furniture and fixtures, . . .	176 12	
for scientific apparatus, . . .	357 48	
for live stock, ...	359 45	
for travelling expenses, . . .	72 72	
for contingent expenses, . . .	273 03	
for building and repairs, . . .	1,255 40	
Cash on hand June 30, 1897, ...	19 73	
		$18,067 01

AMHERST, MASS., Aug. 30, 1897.

I, Charles A. Gleason, duly appointed auditor of the corporation, do hereby certify that I have examined the books and accounts of the Hatch Experiment Station of the Massachusetts Agricultural College for the fiscal year ending June 30, 1897; that I have found the books well kept and the accounts correctly classified as above; and that the receipts for the year are shown to be $33,067.01, and the corresponding disbursements $33,067.28. All the proper vouchers are on file and have been by me examined and found to be correct, there being a balance of $19.73 on accounts of the fiscal year ending June 30, 1897.

CHARLES A. GLEASON,
Auditor.

REPORT OF THE AGRICULTURIST.

WILLIAM P. BROOKS.

Soil Tests.

Four soil tests upon the plan heretofore followed were attempted during the past year; viz., with corn in Norwell and Montague, with potatoes and with onions (and later cabbages) upon our home grounds. Only the tests in Norwell and with potatoes upon our home grounds were successfully carried through.

Unfavorable weather conditions destroyed the onions and cabbages upon our south soil-test acre. The field was sown to white mustard late in July. But four plots furnished sufficient growth to cut and weigh; viz., lime plot, 1 pound; manure plot, 425 pounds; nitrate and dissolved bone-black, 45 pounds; potash and dissolved bone-black, 25 pounds; nitrate, dissolved bone-black and potash plot, 255 pounds,—all green weights.

The field has now been used nine years in soil-test work, and we have a high degree of one-sided exhaustion on most of the plots. The close dependence of the mustard upon a supply of phosphoric acid (furnished by the bone-black) is brought out, as was the case in 1895; but phosphoric acid alone can no longer produce any growth of mustard upon this soil. The addition of either nitrogen or potash helps it, the former most; but not much growth is produced unless all three are supplied.

The soil test with corn in Montague was ruined by wire and cut worms. As nearly as could be determined from the portion of the crop left, nitrogen seemed the most necessary element upon this soil.

1. Soil Test with Corn. Norwell.

This is the second year of soil-test work in this field, the crop last year also being corn. Last year potash was the controlling element; the result this year is the same. Muriate of potash, at the rate of 160 pounds per acre, gives an average increase at the rate of 36.3 bushels of grain and 2,203 pounds of stover; nitrate of soda, at the same rate per acre, gives an average increase of 8.3 bushels of grain and 325 pounds of stover; dissolved bone-black, at the rate of 320 pounds per acre, gives an average increase of 15.3 bushels of grain and 455 pounds of stover. Five cords of manure increase the crop by 26.4 bushels of grain and 3,450 pounds of stover per acre; complete fertilizer (nitrate, dissolved bone-black and potash at above rates) gives an increase of grain 52.5 bushels and stover 2,455 pounds; lime and plaster both produce apparent small increases.

2. Soil Test with Potatoes. Amherst.

The field upon which this test was carried out lies upon our own grounds. It has a medium, well-drained loam, and has been seven years in soil-test experiments. The crops in order of succession have been potatoes, corn, soya beans, oats, grass and clover (two years), and cabbages and Swedish turnips. This year the phosphoric acid gives the largest average increase in crop, viz., at the rate of 26.6 bushels of merchantable tubers per acre; nitrogen gives an increase of 11.3 bushels merchantable tubers and potash an increase of 7.2 bushels. The soil, however, is very generally exhausted, and no single fertilizer or combination of either two or all three gave a good crop. The apparent superiority of the phosphoric acid and nitrogen is chiefly due to the fact that the plot to which those two elements alone were applied was for some reason (not believed to be the effect of the fertilizer alone) nearly twice as great as that upon any other plot. Had the crop where the potash was added to the nitrogen and phosphoric acid been better or even as good as that where the phosphoric acid and nitrogen alone were used, we should be justified in the conclusion

that the nitrogen and phosphoric acid are the elements chiefly required. The crop where all three elements were combined was, however, much inferior to that where the nitrogen and phosphoric acid were used without potash. We must therefore conclude that some disturbing factor, at present unknown, influenced the results; and we are, therefore, unable to draw practical conclusions which throw light upon the proper practice to be followed in manuring the potato crop.

Manure Alone v. Manure and Potash.

An experiment in continued corn culture for the comparison of an average application of manure with a small application of manure used in connection with muriate of potash was begun in 1890. A full account of the results will be found in the annual reports of 1890–95, and in the latter year a general summary of the results is given.

The land used in this experiment was seeded with a mixture of timothy, red-top and clover in the standing corn in July of last year. A good stand of grass and clover was secured, although the latter was rather unevenly developed in different parts of the field, suggesting a possible lack of thoroughness in mixing the seeds.

No manure or potash has been used this year. The field includes four plots of one-fourth of an acre each. The results for 1897 are shown below: —

Plot 1 (1½ cords of manure alone, 1890–96) : hay, 1,420 pounds; rowen, 783 pounds.

Plot 2 (1 cord manure and 40 pounds of muriate of potash, 1890–96) : hay, 885 pounds; rowen, 483 pounds.

Plot 3 (manure alone, as for Plot 1) : hay, 1,380 pounds; rowen, 785 pounds.

Plot 4 (manure and potash, as for Plot 2) : hay, 1,037½ pounds; rowen, 590 pounds.

The averages are as follows: —

Plots 1 and 3 (manure alone, 1890–96) : hay, 1,403½ pounds; rowen, 784 pounds.

Plots 2 and 4 (manure and potash, 1890–96) : hay, 961¼ pounds; rowen, 536½ pounds.

Combining the figures showing the averages of hay and rowen, we find that plots 1 and 3 have produced an average of 2,187 pounds per plot, which is at the rate of 4 tons, 748 pounds, per acre. Plots 2 and 4 have produced an average of 1,497¼ pounds per plot, which is at the rate of 9 pounds less than 3 tons per acre. The larger quantity of manure, then, produced this year about 1⅛ tons more per acre than the manure and potash. This is a large difference, but a difference which was to be anticipated, in view of the much larger quantity of plant food which has been applied to these plots. It remains to be seen whether the clover on plots 2 and 4 will be capable of so enriching the soil in nitrogen as to remove or lessen this difference in succeeding years.

"SPECIAL" CORN FERTILIZER v. FERTILIZER RICHER IN POTASH.

This experiment was begun with a view of comparing the results obtained with a fertilizer proportioned like the average of the "*special" corn fertilizers* found upon our markets in 1891 with those obtained with a fertilizer richer in potash but furnishing less nitrogen and phosphoric acid.

Corn was grown during each of the years from 1891 to 1896 inclusive. From 1891 to 1895 it was found that the fertilizer richer in potash gave the more profitable results. In 1896 there was no practical difference. It was decided during the season of 1896 that it might be possible to derive a greater benefit from the larger quantity of potash applied to two of the four plots if grass and clover should be grown in rotation with the corn. Accordingly the land was seeded with a mixture of timothy, red-top and clover in the standing corn in July, 1896. The field is divided into four plots, of one-fourth of an acre each. The materials applied to the several plots are shown in the following table: —

FERTILIZERS.	Plots 1 and 3 (Pounds each).	Plots 2 and 4 (Pounds each).
Nitrate of soda,	20	18
Dried blood,	30	30
Dry ground fish,	30	20
Plain superphosphate,	226	120
Muriate of potash,	22.5	60
Cost of materials per plot,	$3 23	$3 10

Fertilizers were applied evenly broadcast on April 11. The yields the past year are shown below: —

Plot 1, "special" fertilizer: hay, 795 pounds; rowen, 130 pounds.

Plot 2, fertilizer richer in potash: hay, 810 pounds; rowen, 129 pounds.

Plot 3, "special" fertilizer: hay, 725 pounds; rowen, 97 pounds.

Plot 4, fertilizer richer in potash: hay, 617 pounds; rowen, 165 pounds.

The average yield on plots 1 and 3 is: hay, 760 pounds; rowen, 113½ pounds. On plots 2 and 4: hay, 713½; rowen, 147 pounds. Putting the crops of hay and rowen together, we have an average from 1 and 3 of 873½ pounds, and from 2 and 4 of 860½ pounds. The difference, 13 pounds, is too small to be regarded as of much significance. The greater rowen crop produced by plots 2 and 4 is perhaps to be attributed to the larger amount of potash which has been applied to these plots, which favors especially the growth of the clovers. Inequality of moisture conditions, however, has been the apparent cause of a very uneven development of clover on different parts of the field, and the influence of the potash does not show as clearly as was anticipated.

Natural Phosphates compared with Each Other and with Acid Phosphate. (Field F.)

This series of experiments was begun by Dr. Goessmann in 1890, with a view of determining whether it is not more profitable to employ one of the cheaper natural phosphates than to use the more costly acid phosphate. A full account of the experiment and the results obtained up to the end of 1896 is given by Dr. Goessmann in our ninth annual report. It is only necessary to restate the following points: —

The field was at first divided into five plots, containing about 6,600 square feet each. These plots received equal money's worth (on the basis of prices in 1890) of the phosphates used, as follows: Plot 1, phosphatic slag; Plot 2, Mona guano; Plot 3, at first, apatite; later, Florida phosphate; Plot 4, South Carolina phosphate; Plot 5, dissolved bone-black. Plot 3, as above stated, received an application of ground apatite in 1890. In 1891 it was found impossible to obtain this material, and no phosphate of any kind was applied to this plot. In 1892 and 1893 ground hard Florida phosphate was applied to this plot. It is not believed, however, that it is fair to this phosphate to compare it with the others, since it has been used only two years, while the others have been applied for four years.

From the beginning, each of these five plots has received the same application of nitrate of soda and potash-magnesia sulphate. The quantities of these applied per plot during the first four years were about 44 pounds of the former and 66 pounds of the latter.*

Since 1894 no phosphate of any kind has been applied to these plots, but the quantity of nitrate of soda and of potash-magnesia sulphate has been used in one-half greater quantities.

At first Dr. Goessmann included no plot on which phosphate was not used for comparison with others. Later such a plot was added, but it was left entirely unmanured until 1896. During 1896 and 1897 it has received the nitrate of

* The plots in this experiment differ from each other by a few square feet in size, and the fertilizers have from the beginning varied in proportion as the size varied.

soda and potash-magnesia sulphate at the same rate as the other plots.

The yield of the plots receiving phosphate for each of the years 1890–96 inclusive will be found in our ninth annual report. This report also contains a statement showing the amounts of phosphoric acid applied and removed from each plot during each of these years. This statement shows an excess added over and above that removed from each of the plots at the end of the season of 1896 as follows: where phosphatic slag had been used, the amount of phosphoric acid remaining was 65.6 pounds; where Mona guano had been used, 44.2 pounds; where apatite and Florida phosphate had been used, 141.7 pounds; where South Carolina rock phosphate had been used, 115.0 pounds; and where acid phosphate had been used, 21.8 pounds.

The crop during the past year was Swedish turnips. The field had been sown with rye for winter protection in the fall of 1896. The growth of the rye was characterized as poor. It was ploughed on June 1, the land was harrowed on the 2d, and on the 3d of June, Laing's Swedes were sown in drills two feet apart. The seed germinated promptly and evenly, but the season was much too wet for the best growth of the crop. It was, however, kept free from weeds by frequent cultivation. The crop was thinned on June 20 to eight inches. It was harvested November 2–4. The turnips were poor in quality, small, and a few of them decayed.

The yields of the several plots were as follows: —

	Roots (Pounds).	Tops (Pounds).
Plot 0, no phosphate,	830	185
Plot 1, phosphatic slag,	1,870	480
Plot 2, Mona guano,	3,655	800
Plot 3, Florida hard phosphate,	820	400
Plot 4, South Carolina rock phosphate,	1,965	560
Plot 5, dissolved bone-black,	1,619	370

It will be noticed that the crop on the phosphatic slag, Mona guano and South Carolina rock surpasses that where dissolved bone-black was used, and that the Mona guano gives nearly twice the product obtained by either the slag or the South Carolina rock. It will be further noticed that the Florida phosphate yields practically the same amount of roots as the plot receiving no phosphate. None of the crops secured this year can be regarded as good. The largest yield, that on the Mona guano plot, is at the rate of rather less than 12 tons per acre. A good crop should be about 20 tons per acre. The results of this year, therefore, although showing marked differences, are not regarded as decisive. The peculiarities of the season produced an unhealthy condition, which interfered with the full action of the fertilizers employed.

Comparison of Different Phosphates.

The results of the experiments inaugurated by Dr. Goessmann for the comparison of different phosphates with acid phosphate having proved so interesting and valuable, it was decided to inaugurate another series of experiments, including a greater number of materials supplying phosphoric acid. It was further thought best to apply these materials upon the basis of equal quantities of phosphoric acid to each plot, rather than on the basis of equal money's worth, as in the experiments planned by Dr. Goessmann.

The land selected for the experiment was fairly level, with a medium heavy loam. It had been in grass for many years. In April, 1896, it received an application of 600 pounds of ground bone and 200 pounds of muriate of potash per acre. The season was very dry, and the grass derived little benefit from the fertilizers. The grass was cut about the middle of June, and the field was ploughed on June 24 and 25, 1896, and planted to Longfellow corn. The corn was cut when in the milk, September 26, and weighed as put into the silo. The field had been divided into 13 plots, of one-eighth of an acre each, separated by suitable unmanured strips. The yields of corn in 1896 were as follows: —

Plot 1, 2,640 pounds; Plot 2, 2,990 pounds; Plot 3, 2,915 pounds; Plot 4, 3,555 pounds; Plot 5, 2,885 pounds; Plot 6, 2,905 pounds; Plot 7, 2,850 pounds; Plot 8, 3,020 pounds; Plot 9, 3,160 pounds; Plot 10, 3,095 pounds; Plot 11, 3,000 pounds; Plot 12, 3,090 pounds; Plot 13, 3,440 pounds.

These weights were taken with a view to determining whether these plots were fairly even in fertility. It will be noticed that with three exceptions, plots 1, 4 and 13, this appears to be the case. Plot 1 is apparently poorer than the average, while plots 4 and 13 are better.

In 1897 the soil was thoroughly prepared by the use of the wheel harrow. Fertilizers were applied May 11. Each plot in the field received the following materials: potash-magnesia sulphate, 50 pounds; nitrate of soda, 30¼ pounds; sulphate of potash, high grade, 12½ pounds. These materials supplied the potash and nearly all the nitrogen estimated to be required. Some of the phosphates to be employed (the bone meals), however, contained nitrogen as well as phosphoric acid, and, to equalize conditions on all the plots, sufficient hoof meal was applied to those not receiving bone to make the quantity of nitrogen applied to each plot throughout the field the same.

The plots contained, as stated, one-eighth of an acre each, and the materials used furnished to each plot phosphoric acid, 12 pounds; nitrogen, 6½ pounds; potash, 19 pounds.

The fertilizers used per plot (in addition to nitrate of soda and sulphate of potash which were used alike on each as stated above) are shown below: —

Plot 1: hoof meal, 11¾ pounds. Plot 2: hoof meal, 11¾ pounds; apatite, 32 pounds. Plot 3: hoof meal, 11¾ pounds; South Carolina rock phosphate, 47 pounds. Plot 4: hoof meal, 11¾ pounds; Florida soft phosphate, 45½ pounds. Plot 5: hoof meal, 11¾ pounds; slag, 67¼ pounds. Plot 6: hoof meal, 11¾ pounds; Navassa phosphate, 49 pounds. Plot 7: hoof meal, 11¾ pounds. Plot 8: hoof meal, 11¾ pounds; dissolved bone-black, 70 pounds. Plot 9: hoof meal, $\frac{6}{16}$ pound; raw bone meal, 45 pounds. Plot 10: hoof meal, $1\frac{3}{16}$ pounds; dissolved bone meal, 73¼ pounds. Plot 11: steamed bone meal, 48¼ pounds. Plot 12: hoof meal, 11¾ pounds; acid phosphate, 90½ pounds. Plot 13: hoof meal, 11¾ pounds.

The variety of corn raised was Sibley's Pride of the North, which was planted on May 17, replanted as far as necessary on June 1, and thinned to one plant per foot in the drill early in June. The extraordinary precipitation of the season kept the soil too wet the greater part of the time during the month of July, and the crop was prevented from doing its best. It was cut and stooked September 21, and husked about the last of October.

The yield per plot and the calculated rates per acre are shown below: —

NAMES.	Corn (Pounds).	Stover (Pounds).	Corn per Acre (Bushels).	Stover per Acre (Pounds).
Plot 1, no phosphate, . . .	585	580	58.500	4,640
Plot 2, apatite, ...	565	475	56.500	3,800
Plot 3, South Carolina rock phosphate	645	535	64.500	4,280
Plot 4, Florida soft phosphate, .	725	620	72.500	4,960
Plot 5, phosphatic slag, . .	620	620	62.000	4,960
Plot 6, Navassa phosphate, . .	678¼	610	67.825	4,880
Plot 7, no phosphate, . . .	643¼	542	64.325	4,336
Plot 8, dissolved bone-black, .	618¼	548	61.825	4,384
Plot 9, raw bone meal, . . .	673¼	570	67.325	4,560
Plot 10, dissolved bone meal, .	633¼	550	63.325	4,400
Plot 11, steamed bone meal,. .	503¼	450	50.325	3,600
Plot 12, acid phosphate, . .	628¼	540	62.825	4,320
Plot 13, no phosphate, . . .	673¼	590	67.325	4,720

It will be noticed that one of the best crops in the field was produced where no phosphate was used, and that the yield on the plots to which phosphates were applied varies without apparent relation to the availability of the phosphoric acid in the materials used. Under these circumstances, extended discussion of the results is not called for.

The unfavorable influence of the season and possible differences in natural fertility of the soil serve to obscure the action of the phosphates employed.

Leguminous Crops (Clover, Pea and Bean, or "Pod" Family) as Nitrogen Gatherers. (Field A.)

A full history of the field since 1884 is given by Dr. Goessmann in our ninth annual report. The years 1884–88 were preparatory; the experiment proper began in 1889. The objects in view have been: —

1. To determine the extent to which plants of the clover family are capable of enriching the soil in nitrogen taken by them from the air through the agency of the nodular bacteria found upon their roots.

2. To compare nitrate of soda, sulphate of ammonia, dried blood and barn-yard manure as sources of nitrogen.*

The field is divided into eleven $\frac{1}{10}$ acre plots, numbered from 0 to 10. Three plots, 4, 7 and 9, have received no application of nitrogen-containing manure or fertilizer since 1884. One (0) has received barn-yard manure; two (1, 2), nitrate of soda; three (5, 6, 8), sulphate of ammonia; and two (3, 10), dried blood every year since 1889. These materials have been used in such amounts as to furnish nitrogen at the rate of 45 pounds per acre each year. All the plots have received, yearly, equal amounts of phosphoric acid and potash. The quantities applied have furnished, per acre, phosphoric acid 80 pounds, and potash 125 pounds, from 1889 to 1894 and the past season. In 1895 and 1896 double these quantities were used. Dr. Goessmann reports: † —

> The total yield of crops on the plots receiving no nitrogen, as compared with those receiving nitrogen, was in the several years as follows: —
>
> With corn in 1889, one-fifth less.
> With oats in 1890, one-fifth to one-sixth less.
> With rye in 1891, one-fifth to one-sixth less.
> With soya beans in 1892, one-third to one-fourth less.

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* Only such details are given here as are necessary to a general understanding of the subject; full information is found, as stated above, in our ninth annual report.

† Ninth annual report, Hatch Experiment Station, page 175.

In 1893 the crop was oats, and the yield of grain was from one-seventh to one-eighth less on the plots receiving no nitrogen than the average of those receiving nitrogen. Here the interposition of a leguminous crop (soya bean in 1892) appears to have lessened the proportional inferiority of the plots which received no nitrogen. In 1894 the crop was again the soya bean. The plots without nitrogen give a yield about one-third less than the average of the others. Thus far it will be seen that the soya bean has not shown that degree of independence of soil nitrogen of which it is supposed to be capable. To an even greater degree than the grain crops it is benefited by nitrogen manuring. This fact may perhaps be accounted for because of conditions unfavorable to bacterial life in this soil; but as to the nature of such unfavorable conditions we are at present ignorant.

In 1895 the crop was oats, and results showed no improvement in proportional yield on the plots receiving no nitrogen which could be attributed to the preceding bean crop. This may be in part due to the fact that the bean has a rather limited root system, and leaves behind but little stubble.

In 1896 the crop was again the soya bean, which once more showed marked inferiority on the no-nitrogen plots. An attempt to seed the land to clover in the standing beans proved a failure, on account of the dry season and the too dense shade made by the crop of beans.

The crop the past season has been oats. The yield per plot of straw and grain, the rate per acre and remarks upon the quality of the grain are given below. In this table the no-nitrogen plots are italicised.

Nitrogen Experiment.

PLOT.	WEIGHT PER PLOT ONE-TENTH ACRE.		YIELD PER ACRE.		REMARKS ON GRAIN.
	Straw (Pounds).	Oats (Pounds).	Straw (Pounds).	Oats (Bushels).	Kernels.
Nitrate of soda, . .	500	159	5,000	49.68	Light.
Nitrate of soda, . .	400	147	4,000	45.93	Light.
Dried blood, . .	215	122	2,150	38.12	Good.
No nitrogen, . .	*120*	*69*	*1,200*	*21.56*	Good.
Sulphate of ammonia, .	340	137	3,400	42.81	Poorer than No. 3.
Sulphate of ammonia, .	275	97	2,750	30.31	Good.
No nitrogen, . .	*120*	*77½*	*1,200*	*24.21*	Good.
Sulphate of ammonia, .	350	127	3,500	39.68	Good.
No nitrogen, . .	*130*	*75*	*1,300*	*23.43*	Good.
Dried blood, . .	220	126	2,200	39.37	Fair.
Barn-yard manure, .	220	125	2,200	39.06	Fair.

Calculation shows that the average total weight of crop is a little less than one-half as great on the plots not manured with nitrogen as the average of the other plots. The crop of grain is a little more than one-half as great. We find, then, not the least evidence of any ability on the part of the soya bean when grown before a grain crop (and harvested) to make nitrogen manuring of the grain crop unnecessary. On the contrary, the proportional yield of the no-nitrogen plots is this year the lowest it has ever been in these experiments.

The Relative Value of the Different Manures furnishing Nitrogen.

The nitrate of soda gives the largest crop. Next in order of yield come the barn-yard manure, dried blood and sulphate of ammonia; but between these there is not much difference. On plots 2, 3, 4, 6, 7, 8 and 9 the source of potash is the muriate; on all others it is double sulphate of

potash-magnesia. The yield of oats is in every instance greater where the sulphate is used under otherwise similar manuring. The superiority is most marked when sulphate of ammonia is the source of nitrogen.

Muriate compared with Sulphate of Potash in connection with Sulphate of Ammonia for Corn.

Results obtained with different crops in the special nitrogen tests on Field A during previous years having indicated an injurious effect, due to the combination of muriate of potash and sulphate of ammonia,* it was decided to undertake experiments upon a larger scale, with the view of bringing out more clearly the significance or importance of this effect. Accordingly two plots of land of one-half acre each, lying on the east side of the highway, were set apart for this experiment. This land had previously been used in experiments to determine the relative value of phosphatic slag and ground bone as sources of phosphoric acid. These experiments were begun in 1894 and continued until 1896. The crops had been oats, corn and millet. An account of these experiments will be found in the annual reports covering the years named.

The following fertilizers were applied this year, broadcast, after ploughing, and harrowed in: —

North plot: sulphate of ammonia, 152 pounds; muriate of potash, 120 pounds; acid phosphate, 160 pounds.

South plot: sulphate of ammonia, 152 pounds; sulphate of potash, 120 pounds; acid phosphate, 160 pounds.

The fertilizers were applied May 11. The crop was planted in drills three and one-half feet apart, May 17. The variety was Sibley's Pride of the North.

The soil throughout the season was too wet for the best growth of the corn crop. The crop was harvested on September 6, and put into the silo. The yield was as follows:

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* For a full discussion of this subject see Dr. Goessmann's paper in the annual report of the Hatch Experiment Station for 1897, pages 222 and 223.

north plot, 5,760 pounds; south plot, 5,255 pounds. The difference is too small to afford a basis for a positive judgment as to the merits of the two forms of potash applied.

Fertilizers for Garden Crops.

In 1891 Dr. Goessmann began a series of experiments for the comparison of sulphate of ammonia, nitrate of soda and dried blood as sources of nitrogen for various garden crops. Sulphate of potash was employed to furnish potash. In 1892 the scope of the experiment was enlarged by including three additional plots, comparing the same materials as sources of nitrogen with muriate of potash used as a source of potash. The results of these experiments are fully discussed in Dr. Goessmann's reports. The following table shows the different fertilizers applied to the several plots: —

Plots.	Annual Supply of Manurial Substances.	Pounds.
Plot 1,	Sulplate of ammonia,	38
	Muriate of potash,	30
	Dissolved bone-black,	40
Plot 2,	Nitrate of soda,	47
	Muriate of potash,	30
	Dissolved bone-black,	40
Plot 3,	Dried blood,	75
	Muriate of potash,	30
	Dissolved bone-black,	40
Plot 4,	Sulphate of ammonia,	38
	Sulphate of potash,	30
	Dissolved bone-black,	40
Plot 5,	Nitrate of soda,	47
	Sulphate of potash,	30
	Dissolved bone-black,	40
Plot 6,	Dried blood,	75
	Sulphate of potash,	30
	Dissolved bone-black,	40

The area of the plots is about one-eighth of an acre each. The fertilizers used supply at the rates per acre: phosphoric acid, 50.4 pounds; nitrogen, 60 pounds; potash, 120 pounds.

The crops raised during the past year were garden peas, beets, squashes and celery.

Garden Peas. — The land was ploughed April 19, fertilizers applied and harrowed in April 21, and the seed planted on April 22. On June 7 it was noticed that the growth of the vines on Plot 1 was distinctly inferior to that on the other plots, and it so continued throughout the season. The pods produced by the vines upon this plot were short, but well filled, as were they also upon Plot 4. The growth of vines upon plots 3 and 6 may be characterized as medium; upon plots 2 and 5 the growth was rank. The pods upon these two plots were large, but not well filled. Three pickings of peas were made. The yield of green peas, as well as of vines, is shown in the following table: —

Green Peas (Pounds).

DATE.	Muriate of Potash.			Sulphate of Potash.		
	Plot 1.	Plot 2.	Plot 3.	Plot 4.	Plot 5.	Plot 6.
July 12, ...	100	93	99½	165	179	195
July 19, ...	66	150	132	143	134	91
July 23, ...	11	60	49	40	30	21
	177	203	280½	348	343	307

Green Vines (Pounds).

July 23, ...	102½	210	240	240	205	180

The average yield of green peas produced by the different fertilizers is shown in the following table: —

	Pounds.
Average of muriate plots, ...	220⅙
Average of sulphate plots, ...	332⅔
Average of sulphate of ammonia plots, ...	262½
Average of nitrate of soda plots, ...	273
Average of dried blood plots, ...	293⅓

It will be noticed that the sulphate of potash appeared to be distinctly superior to the muriate, that the dried blood gives a larger crop than either of the other sources of nitro-

gen, but that there is not a great difference between the three materials used to supply this element. The best crop is produced where sulphate of ammonia and sulphate of potash are used. The crop where nitrate of soda and sulphate of potash are used is not, however, materially inferior.

Beets. — The variety raised was the Eclipse. Fertilizers were applied as stated above, seed planted April 22, vacancies filled May 20. The growth of the beets upon Plot 1 was noticed early in the season to be distinctly inferior to that on the other plots, and before the close of the season most of the plants upon this plot were dead. On July 27 the crop was harvested. The yield of the several plots was as follows: Plot 1, 133 pounds; Plot 2, 711 pounds; Plot 3, 358 pounds; Plot 4, 448 pounds; Plot 5, 793½ pounds; Plot 6, 478 pounds.

The averages of the different fertilizers are shown below: —

	Pounds.
Average of muriate plots,	400⅔
Average of sulphate plots,	573⅙
Average of sulphate of ammonia plots,	290½
Average of nitrate of soda plots,	752¼
Average of dried blood plots,	418

It will be noticed that the sulphate of potash appears to be greatly superior to the muriate, and nitrate of soda is far ahead of sulphate of ammonia as a source of nitrogen for this crop. The best yield is produced where nitrate of soda and sulphate of potash are used together.

Squashes and Celery. — Both of these crops were failures, on account of the unfavorable weather. The celery plants, it is true, lived, but many of them made no growth. The plants were cut close to the ground on October 18, many of them being, if anything, smaller than when set. The cuttings were weighed, with the following results: Plot 1, 28½ pounds; Plot 2, 57 pounds; Plot 3, 35½ pounds; Plot 4, 28 pounds; Plot 5, 92 pounds; Plot 6, 24 pounds.

It is noticeable that here again Plot 5, where nitrate of soda and sulphate of potash were used, is the best; but even this did not produce a crop with any marketable value.

Injurious Effect of Sulphate of Ammonia and Muriate of Potash used together. — Particular attention is called to the fact that upon Plot 1, where sulphate of ammonia and muriate of potash are used together, the growth was, in the case of the peas and beets, decidedly inferior to that upon the other plots. This inferiority may undoubtedly be ascribed to the poisonous effect of the chloride of ammonia formed where these fertilizers are used together, to which Dr. Goessmann has called especial attention.

Experiments on Grass Land.

The system of manuring grass lands, planned by Dr. Goessmann and described by him in previous reports, has been continued. According to this system, the land receives one year a dressing of barn-yard manure at the rate of 8 tons per acre; the next year, wood ashes at the rate of 1 ton per acre; and the third year, ground bone 600 pounds, and muriate of potash 200 pounds, per acre.

Plot 1, which this year received ashes, gave a yield at the rate of 5,775 pounds of hay and 3,204 pounds of rowen per acre, — a total of 4 tons 979 pounds. Plot 2, which received manure applied in the fall of 1896, produced at the rate of 5,784 pounds of hay and 2,627 pounds of rowen per acre, — a total of 4 tons and 411 pounds. Plot 3, which this year received bone and potash, produced at the rate of 6,183 pounds of hay and 2,755 pounds of rowen per acre, — a total of 4 tons 938 pounds.

This system of using these different manures for grass lands in rotation has much to recommend it. It is simple, and has certainly given remarkably good crops. I believe, however, that the system would be improved by the use of a little nitrate of soda, say 150 pounds per acre, with the ashes as well as with the bone and potash.

Experiments with Nitragin, a Germ Fertilizer.

Nitragin, prepared according to the directions of Professor Nobbe, was imported at my suggestion from Germany in the summer of 1896. The material was fully described

by Dr. Goessmann in our last annual report, and full directions for its use are quoted by him.

The nitragin has been tried in accordance with directions, as stated elsewhere in this report, upon crimson clover and alfalfa, without apparent benefit. It has also been tried upon common red clover. On this crop, as with the others, no difference in growth attributable to the nitragin has been noticed; and, so far as can be judged at the present time, the use of this germ fertilizer for our common clovers is not to be advised. Nitragin undoubtedly contains the germs of the appropriate nodular bacteria, — the name of Professor Nobbe is sufficient guarantee of this. The failure of the material to benefit the crop appears to be due to the fact that our soils contain the nodular bacteria of the common leguminous crops in sufficient numbers so that the addition of a few more by the use of nitragin counts for nothing. Experience in the open field in most parts of Germany and England has been similar to our own, and I believe that we may safely conclude that only when we are about to begin the culture of a leguminous crop new to a particular locality will it be found advantageous to employ nitragin. In such cases the soil lacks the appropriate nodular bacteria; nitragin furnishes these, and the result is a better growth, because the crop is enabled to make use of the free nitrogen of the air from the first, which it could not do in the absence of the proper bacteria.

Sulphate of Iron as a Fertilizer.

Sulphate of iron has been tried during the past season upon the same plots as in 1896, but this year with corn as a crop. The sulphate of iron is used at the rate of 80 pounds per acre. The crop where it was employed was a little inferior to that on the plots where it was not used. Without sulphate of iron the average yield of the plots was 58¼ pounds of corn and 163¼ pounds of stover; with sulphate of iron, 50¾ pounds of corn and 160 pounds of stover.

VARIETY TESTS.

1. Corn.

Twenty of the more promising varieties of corn tried for the first time last year have been given a further trial during the past season. Nine of these varieties were flint corns, as follows, named in the order of productiveness: Sanford, Longfellow, Waushakum, Giant Long White, Rhode Island White Cap, Early Canada, King Philip, Angel of Midnight, Compton's Early. The varieties of dent corn, named in order of productiveness, were Early Butler, Leaming Field, Champion White Pearl, Queen of the Prairie, Iowa Gold Mine, King of the Earlies, Sibley's Pride of the North, South Dakota White, Huron Extra Early, Wisconsin Yellow and White Cap Yellow.

Varieties the ears of which were very moist when husked are Queen of the Prairie and Huron Extra Early. Varieties which were moist are White Cap Dent, Leaming Field, Iowa Gold Mine and Champion White Pearl.

All of the varieties in these two classes are too late for culture as grain crops in this locality, though they would do for the silo.

2. Potatoes.

Eighty-one varieties of potatoes were cultivated for purposes of comparison. upon the general plan described in our last report (ninth). The soil was a well-drained medium loam. The fertilizers used per acre were as follows: —

	Pounds.
Nitrate of soda,	240
Acid phosphate,	400
Sulphate of potash (high grade),	250
Tankage,	240
Dried blood,	100

These materials were mixed and scattered broadly in the furrows before dropping the seed. The seed was planted April 30. May 5 the crop was somewhat injured by washing of the soil between the rows and by the excessive rainfall. The potatoes were dug September 26 to October 6. The yield was at the rate of from 115.7 to 282.4 bushels per acre. The eleven largest yields of merchantable tubers,

in the order of productiveness, were given by the following varieties: Rose No. 9, Restaurant, Woodbury's White, Bliss's Triumph, Prolific Rose, Empire State, Early Maine, Dakota Red, Sir William, Early Rose and Beauty of Hebron. All of these gave a product at the rate of more than 220 bushels of merchantable tubers per acre. Again, as last year, we find the two old standard sorts, Early Rose and Beauty of Hebron, ranking among the very best. It appears doubtful whether any among all those tried are truly superior to these varieties.

Twenty-three varieties have given yields of merchantable tubers at the rate of less than 175 bushels per acre. These, in the order of inferiority, are the following: Minister, Bill Nye, Harbinger, Peerless, Jr., Livingston Banner, Burpee's Extra Early, Carmen No. 3, Dandy, Early Market, Crown Jewel, Merriman, White Star, Irish Daisy, Chance, Six Weeks, Alliance, Sunlit Star, World's Fair, Freeman, Ohio, Jr., Great Divide, Wise Seedling and Early Norther.

All of the varieties grown this year are to be examined for determination of dry matter and starch, but this work could not be completed in season for this report. Full details as to the varieties cultivated are therefore reserved until these analytical results can be published.

3. Grasses.

Sixty species and varieties of grasses have been under trial. Most of them occupied plots containing one square rod. About one-half of these grasses were sown in the spring of 1896. Among those so sown the following varieties winter-killed: English rye grass, Italian rye grass, crested dog's-tail and meadow fescue. Among comparatively little-cultivated varieties which appear promising may be mentioned the following: tall oat grass, tall fescue, red fescue, fowl meadow, Canada blue-grass, water-spear grass and wood-meadow grass.

The yield of the dry matter in the hay and rowen (where any was secured) of those varieties sown in the spring of 1896 during the past season, with date of cutting of both

the first and the second crops, is shown in the following table. The area in each variety was one square rod.

KINDS.	Date of cutting Hay.	Dry Matter in Hay (Pounds).	Date of cutting Rowen.	Dry Matter in Rowen (Pounds).
Timothy (*Phleum pratensis*), .	July 1,	19.36	Sept. 11,	6.44
Awnless Broom (*Bromus inermis*),	June 25,	14.71	Sept. 11,	6.44
Yellow Oat (*Avena flavescens*), .	July 1,	-	Sept. 11,	4.41
Sweet Vernal (*Anthoxanthum odoratum*).	June 4,	2.98	Sept. 11,	4.41
Meadow Foxtail (*Alopecurus pratensis*).	May 17,	5.70	June 25,	7.87
Red-top (*Agrostis vulgaris*),. .	July 6,	31.12	Sept. 11,	8.44
Rhode Island Bent (*Agrostis Canina*).	July 6,	30.81	Sept. 11,	6.41
Fall Oat (*Arrhenatheum avenaceum*).	June 25,	22.85	Sept. 11,	11.86
Glyceria fluitans, ...	July 1,	-	Sept. 11,	-
Meadow soft (*Holcus lanatus*), .	June 25,	10.25	Sept. 11,	6.42
Slender Fescue (*Festuca tennuifolia*).	June 15,	21.43	-	-
Meadow Fescue (*Festuca pratensis*).	Sept. 11,	4.36	-	-
Sheep's Fescue (*Festuca ovina*), .	June 15,	27.85	Sept. 11,	6.61
Tall Fescue (*Festuca elatior*), .	June 25,	27.20	Sept. 11,	17.81
Hard Fescue (*Festuca durinscula*),	June 15,	27.42	Sept. 11,	-
Orchard (*Dactylis glomerata*), .	June 15,	16.41	Sept. 11,	11.96
Red Fescue (*Festuca rubra*), .	June 25,	27.47	Sept. 11,	-
Fowl Meadow (*Poa serotina*), .	July 6,	43.00	Sept. 11,	14.27
Rough-stalked Meadow (*Poa trivialis*).	July 1,	9.87	Sept. 11,	-
Kentucky Blue (*Poa pratensis*), .	June 15,	14.73	Sept. 11,	18.93
Canada Blue (*Poa compressa*), .	July 10,	43.68	Sept. 11,	6.17
Water Spear (*Poa aquatica*), .	July 1,	31.97	Sept. 11,	8.04
Canary Reed (*Phalaris arundinaria*).	June 25,	23.18	Sept. 11,	21.09
Wood Meadow (*Poa nemoralis*), .	July 1,	31.07	Sept. 11,	12.88
Creeping Rent (*Agrostis stolonifera*).	July 6,	15.27	Sept. 11,	-

4. *Millets.*

Twenty-one varieties of millet, occupying one square rod each, were grown for purposes of comparison on medium loam, manured at the rate of 600 pounds of ground bone and 200 pounds of muriate of potash per acre. These were of three species, *Panicum crus galli*, *P. miliaceum* and *P. italicum*. The varieties grown, with particulars concerning amount of seed sown, date of heading, height of plants, and the weight per plot and acre of hay produced, are shown in the table below: —

KINDS.	Ounces Seed Sown.	Date of Heading.	Date When Cut.	Height of Plants (Feet).	Weight, Air Dry, Square Rod (Pounds).	Weight per Acre (Pounds).
Panicum crus galli.						
Japanese barn-yard, . . .	1	Aug. 2,	Aug. 17,	6	65	10,400
Japanese barn-yard, loose headed.	1	Aug. 2,	Aug. 17,	6	63	10,080
Panicum miliaceum.						
Common broom corn, . .	3	July 19,	Aug. 2,	4	51	8,160
Japanese broom corn, red seed,	3	Aug. 2,	Aug. 21,	4 -6	83	13,280
Japanese broom corn, white seed.	5	Aug. 10,	Aug. 29,	5½-6	92	14,720
California, ...	4	July 19,	Aug. 2,	4	62	9,920
Chinese, ...	4	July 23,	Aug. 5,	4	69	11,040
French, ...	4	July 23,	Aug. 5,	4	66	10,560
White French, ...	4	July 19,	Aug. 2,	3½-4	65	10,400
Red French, ...	4	July 19,	Aug. 2,	-	65	10,400
Hog, ...	4	July 19,	Aug. 2,	3 -3½	63	10,080
Panicum italicum.						
Canary bird seed, . . .	4	Aug. 7,	Aug. 2,	-	40	6,400
Dakota, ...	4	July 28,	Aug. 12,	3½-4	60	9,600
Early Harvest, ...	4	July 19,	Aug. 2,	3 -3½	57½	9,340
Golden, ...	3	Aug. 21,	Sept. 4,	5	100	16,000
Golden Wonder, . . .	4	Aug. 10,	Sept. 4,	5	95	15,200
Japanese Glutenous Hokkaido,	3	Aug. 12,	Aug. 26,	4½	63	10,080
Japanese Glutenous Mukodamashi.	3	-	Sept. 15,	2 -4	100	16,000
Japanese common Millet, .	3	Aug. 12,	Aug. 26,	4½	88	14,080
New Siberian, ...	4	July 28,	Aug. 12,	3 -4	55	8,800

The differences in yield are large, but the scale upon which the varieties were grown is small, — too small, in my judgment, to justify sweeping conclusions as to the relative merits of the several sorts.

The "Dakota" closely resembles the "Early Harvest;" the "loose-headed" variety of the "barn-yard" millet is much less leafy and less valuable than the common form. The so-called "Golden Wonder" cultivated appeared to be like the "Golden." The "Japanese Glutenous," from "*Mukodamashi*," is very late, and does not mature with us. The variety of glutenous millet from *Hokkaido* appears to be a valuable sort. Moisture tests which are being made will very likely change the relative position of some varieties.

5. *Japanese Millets for Seed.*

A small area of each of our three leading varieties of Japanese millets was grown for seed. The soil was fertilized for each variety at the following rate per acre, the fertilizer being sown broadcast and harrowed in: —

Manure,	4 cords.
Nitrate of soda,	125 pounds.
Dried blood,	100 "
Tankage,	200 "
Superphosphate,	250 "
Muriate of potash,	200 "

The season was not very favorable for these crops, and they were somewhat injured on several occasions by the washing of the soil, due to excessive rain-fall.

Barn-yard Variety (*Panicum crus galli*). — The area sown to this variety was .633 acres. The seed was sown May 27, in drills, and was cultivated and hand-weeded. It yielded 1,370 pounds of seed and 4,360 pounds of straw, which is at the rate of 40 bushels of seed and 3 tons 888 pounds of straw per acre.

Japanese Broom-corn Millet (*Panicum miliaceum*). — The area of this variety was .248 acres. It was planted and cultivated like the preceding variety. The yield was 535 pounds of seed and 1,620 pounds of straw, which is at

the rate of 40 bushels of seed and 3 tons 532 pounds of straw per acre.

Japanese Millet (Panicum italicum). — The area of this variety was .138 acres. It was planted and managed in all respects like the preceding varieties. The yield was 305 pounds of seed and 519 pounds of straw, which is at the rate of 41 bushels of seed and 1 ton 1,761 pounds of straw per acre.

6. *Soya Beans.*

A small area of each of the three leading varieties of Japanese soya beans was cultivated for seed. The yield was at the following rates per acre: early white, 18.7 bushels; medium black, 16 bushels; medium green, 34.5 bushels. The last-named variety thus once more demonstrates its great superiority as a crop-producer over either of the other sorts under trial.

7. *Clovers.*

Tests were begun in 1895 for the purpose of comparing four of our prominent clovers, viz., medium red, mammoth, alsike and crimson. The result of the first year's test will be found in our ninth annual report (pages 27 to 29). As stated in that report, our results indicate that the crimson will not prove valuable as a fodder crop in this locality.

Medium Red Clover. — The crop of this variety compared very favorably with that of the mammoth clover in the season of 1896, but during the winter of 1896 and 97 the plants of this variety were nearly all killed. The plots were accordingly ploughed and sown with oats and vetch.

Mammoth Clover. — This variety was somewhat injured by the winter, but was allowed to stand. Bad weather prevented its being harvested at the proper time, and it was much damaged before it could be secured. It yielded at the rate of about 1½ tons per acre at the first cutting. The second growth was much mixed with weeds. It was cut and weighed green, yielding at the rate of about 2,800 pounds per acre.

Alsike Clover. — This variety, like the preceding, was much injured by rain. It, like the mammoth, was found to have suffered much during the winter. The crop cut was

much mixed with weeds, yielding at the rate of 2¼ tons per acre for the first cutting. The second growth was mostly weeds, and was weighed green, amounting to about 5 tons per acre.

Conclusion. — The mammoth clover under the conditions of our experiment has shown greater vitality and productive capacity than either of the other sorts. It is worthy more extensive cultivation.

Sulphate v. Muriate of Potash for Clovers. — As stated in our ninth annual report, there were two plots of each of the varieties of clover under comparison, one fertilized with muriate of potash, the other with sulphate of potash. The results in 1896 showed no material difference in yields which could certainly be ascribed to the nature of the potash salts used. The same is true this year.

The sulphate plots, both of the mammoth and the alsike clovers, yielded most at the first cutting; the muriate plots, in both cases, yielded most at the second cutting; but, as stated, the crops secured at the second cutting were largely mixed with weeds. The results, therefore, must be regarded as without especial significance.

8. Sweet Clover (Melilotus alba).

This crop occupied two plots of two-fifteenths of an acre each, in Field B. The same crop was grown upon these plots in 1896, and the results are fully discussed in our ninth annual report. The growth during that season was for the most part small and unsatisfactory, owing apparently to the fact that the appropriate nodular bacteria were not present in sufficient numbers to enable the crop to make use of free atmospheric nitrogen. A few of the plants in 1896 were found to have abundant nodules upon their roots. These showed a deep-green color and made a vigorous growth. It was judged that, if the land should be thoroughly worked in various directions, the nodular bacteria would be scattered throughout the soil, and that the second crop upon the same land would be better than the first. The soil was accordingly thoroughly prepared, and the seed for the crop of this year sown at the rate of 10 pounds per acre on July 30, 1896.

The growth was very much superior to that of the previous year, and upon examination in the early part of the season it was found that the roots of about one-half the plants were abundantly supplied with nodules. These plants were making a vigorous growth, and had a deep-green color, indicative of an abundant supply of nitrogen. They were at this time evidently able to draw upon the atmosphere for this element. Later the other plants in the field seemed also to gain this ability.

On July 8 the crop averaged 6 feet in height. A portion was cut and fed to the cows kept in the department of foods and feeding. This portion yielded at the rate of about 12½ tons per acre. Dr. Lindsey reports that the cows ate it readily and appeared to be fond of it. It was, however, rather coarse for feeding when allowed to stand until the latter part of July. If to be fed, the crop should be cut early. In average seasons it would be at its best condition during the first half of the month of July. It is not, however, as a fodder crop that I am inclined to recommend a trial of sweet clover, but rather as a crop for green manuring. I believe it may serve here a similar purpose to that served by crimson clover in localities where it is hardy.

Miscellaneous Crops.

Alfalfa. — One-quarter of an acre of light soil was sown on April 17 with alfalfa. The fertilizer applied to the quarter acre was as follows: fine-ground bone, 100 pounds; nitrate of soda, 50 pounds; phosphatic slag, 50 pounds; muriate of potash, 50 pounds. One-half the seed used was treated with nitragin. All the seed germinated quickly, no difference being noticed between the treated and the untreated. The small plants were, however, injured by the heavy rains, and up to date the crop has made but a feeble growth.

Saccaline. — Our trial of this crop has been carried out upon two small plots, the one having a heavy, moist soil, the other a light, drier soil. One-year-old plants were set in the spring of 1896. The growth during that season was feeble. In August of that year each plot was given a good

dressing of manure. In the spring of 1897 it was found that a considerable number of the plants had been winter-killed. On the heavy soil 36 out of 408, and on the lighter soil 71 out of 129, were dead; of 451 plants left in a nursery, 258 were dead. Plants which lived through the winter were well started by April 20, but the new growth was killed by a frost. On July 16 the growth, which ranged from 1 to 7 feet in height, the average being about 3 feet, was cut. The plants were large and woody. The yield on the heavy soil, 408 plants, was 295 pounds; on the lighter soil, 129 plants, 132 pounds. The leaves only were eaten by cows, — horses would not eat it at all. A second crop was not cut, but on October 1, when the plants were killed by frost, the second growth averaged about 18 inches in height. As a result of our trial of this crop, I am convinced that it is without value as a fodder crop for us.

Crimson Clover. — A further trial of this crop has been made upon a rather light soil. The seed was sown July 3 with equal parts of winter rye. Nitragin, not received in season to apply with the seed, was mixed with water, according to directions, and applied to the clover August 31, the plants then standing about 2 inches high. The crop was a complete failure, every plant being winter-killed.

Winter Vetch. — A small plot of this crop has been grown upon a light soil. It was sown August 20, equal parts of vetch and rye. This vetch proved perfectly hardy and grew vigorously, reaching a greater height than the rye. This vetch will prove valuable as a green fodder when sown with winter rye.

Besides the above, we have cultivated a few rows each of a large variety of fodder plants, some 39 in number. In this variety are included a large number that have been mentioned in previous reports, and they do not require further notice at this time.

Among those cultivated for the first time this year are the *Idaho field or coffee pea* (*Cicer arietinum*). This appears to be the same as the gram or chick pea, which we have had under cultivation for two years. The growth is too small to make it valuable for a fodder crop.

Another new fodder crop for this year was the *Brazilian stooling flour corn.* The plants made a vigorous growth, but are judged to be too coarse and woody to prove of much value for fodder.

Black chaff or African millet is another crop under trial this year for the first time. It appears to be the same as Kaffir corn, and, as reported last year, our experience leads us to regard this fodder crop as inferior to maize for our climate.

A Reputed Method for Destroying Stumps.

A correspondent in one of our agricultural papers during the summer of 1895 reported that he had found it possible to destroy stumps in the following manner: —

A hole one or two inches in diameter according to the size of the tree, and eighteen inches deep, is to be bored in the stump. Into this put from one and one-half to two ounces of saltpetre, fill with water and plug tightly. Six months later, put into the same hole about one gill of kerosene oil, and set fire to it. The correspondent stated: "The stump will smoulder away without blazing, even down to every part of the roots, leaving nothing but ashes."

On Nov. 4, 1895, fifty stumps of trees cut in 1894, including the following varieties, maple, hickory, hemlock, white pine, yellow birch and elm, were bored according to directions. On December 11 saltpetre and water were put into the holes, according to directions, and the holes plugged. During July, 1896, the plugs were removed, the holes were filled with kerosene, and an attempt made to burn the stumps. It was found that not even the oil would burn. A portion of the stumps were left until June, 1897, when another attempt was made to burn them, using a low-test oil, called paraffine gas oil. The stumps are still in the field. The method has been given a thorough trial, but must be regarded as a complete failure.

Poultry Experiments.

Experiments with poultry were carried out during the winter of 1896 and 1897. Our attention was confined to three points: —

1. Effect upon egg-production of the use of condition powders.

2. Comparative value for egg-production of dry-ground animal meal and cut fresh bone.

3. Comparative value for egg-production of cut clover and fresh cabbage.

General Conditions.

In all of these experiments pullets purchased in Plymouth County and sent to us in December were used. A few had laid before we received them, and production was stopped by the move, as is generally the case. Some of the pullets moulted after reception here, which served to reduce the egg yield. Each of the six lots of fowls occupied a house, with roosting and laying room ten by twelve feet, and scratching shed eight by twelve feet in size. Each had the liberty of a large yard, which furnished a little grass after April 15, but in all alike. Each of the feeding trials began January 1 and continued until May 2, — 122 days.

Soft foods were mixed for the morning mash with boiling water the night before using. Sufficient of the materials for a fortnight were mixed dry at one time. Oats were always scattered in the straw in the shed at noon. At night the wheat was fed in the same manner. As a rule, a little cut bone was fed once a week, in place of the noon ration of oats. About twice a week cabbage was hung up in each coop except the one where cut clover was under comparison with this vegetable. Clear water, shells and grit were before the fowls all the time. Occasionally salt was added to the morning mash. At the conclusion of the experiment the dressed fowls were sent to G. M. Austin & Son, Boston, who reported upon the quality of the several lots.

1. Effect of Condition Powder upon Egg-production.

This experiment was carried out in most respects in the same manner as last year. Light Brahmas were selected for this test, 20 in the coop receiving condition powders and 19 in the other. The food of the two lots was the same

in kind, with the exception that the fowls in House No. 6 received daily condition powder in the morning mash, in accordance with directions furnished with the powder.

The kinds and amounts of food used are shown in the table: —

KINDS.	AMOUNTS (POUNDS).	
	No Condition Powder.	Condition Powder.
Wheat,	209	220
Oats,	150	150
Bran,	27	28
Middlings,	27	28
Animal meal,	27	28
Clover,	27	28
Cabbage,	28	29
Corn meal,	28	29¼
Bones,	9	9

About three pounds of condition powders were used in the experiment.

The weights of the fowls were taken at intervals, and were as follows: —

Average Weights (Pounds).

	No Condition Powder.	Condition Powder.
January 4,	4.868	4.650
February 4,	5.260	4.950
March 9,	5.360	5.343
April 26,	5.310	5.470
May 3 (after fasting twelve hours),	5.160	5.180
Dressed weight,	4.605	4.657

The results and leading details are shown below: —

Condition Powder for Egg-production.

Experiment January 1 to May 2.	Number of Hen Days.	Gross Cost of Food.	Cost per Hen Day.	Cost of Food per Egg.	Number of Eggs.	Weight of Eggs.		Weight per Egg (Ounces).
						lbs.	oz.	
No condition powder,	2,318	$6 61	$0 00285	$0 0124	532	65	1¼	1.958
Condition powder, .	2,354	6 68	00280	0125	540	67	4	1.993

The nutritive ratio was 1 : 5.16 for the fowls not receiving condition powder; for the others, 1 : 5.14,— practically identical. The total dry matter in food consumed for each egg produced was: without condition powder, 0.8349 pounds; with powder, 0.8688 pounds. Besides the perfect eggs as shown in above table, the fowls receiving no condition powders laid three soft-shelled eggs; the others, one. There were five sitters in the first lot, eleven in the second.

Samples of the eggs were analyzed, and those from the condition-powder fowls were found somewhat richer in dry matter, protein and fat. The eggs were also tested in two families by careful house-keepers. The reports did not agree in all particulars; but one of the two found the eggs from the fowls which had received condition powders superior in flavor of yolk, flavor of white, in beating qualities and in consistency; the eggs from the other fowls better in color and size of yolks. The other reported the condition-powder eggs strong in flavor and the yolks small. This discrepancy is probably to be accounted for from the fact that the number tested was small. Individual as well as class differences would almost certainly be found in the eggs.

The fowls which had received condition powder were reported as dressing rather better than the other lot.

One fowl in the condition-powder house died during the test; there were no losses in the other house.

In conclusion, I have to say that the differences found in this experiment are too small to be considered decisive. On the side of the condition powder we have size of eggs and

weight and quality of the dressed fowls; against the powder, we have the food cost per egg, the weight of dry matter in food per egg, and the loss of one fowl. We are warranted simply in the statement that the powder does not appear to have paid for its use.

2. *Cut Bone v. Animal Meal for Egg-production.*

Each of the two houses contained twenty Plymouth Rock pullets in this experiment. The bone and animal meal were each mixed in the morning mash. The foods used are shown below: —

KINDS.	Cut-bone House (Pounds).	Animal-meal House (Pounds).
Wheat,	213	196
Oats,	149	149
Bran,	27	28
Middlings,	27	28
Buffalo gluten,	-	28
Animal meal,	-	28
Clover,	28	27
Cabbages,	26½	29⅛
Chicago gluten,	27	-
Cut bone,	28	-

The nutritive ratios in the two houses were 1 : 5.05 and 1 : 4.45 respectively.

The average weights of the fowls were as follows: —

	Cut-bone House (Pounds).	Animal-meal House (Pounds).
January 4,	4.75	4.89
February 6,	5.10	5.00
March 9,	5.86	5.28
April 27,	5.44	5.15
May 3 (after fasting twelve hours),	5.28	4.88
Dressed weight,	4.83	4.43

The dressed fowls which had received the cut bone were reported slightly better than the other lot. The leading details and results are shown in the following table: —

Cut Bone v. Animal Meal.

Experiment January 1 to May 2.	Number Hen Days.	Gross Cost of Food.	Cost per Hen Day.	Cost of Food per Egg.	Number of Eggs.	Weight of Eggs.		Weight per Egg (Ounces).
						lbs.	oz.	
Cut-bone house, .	2,279	$6 61	$0 0028	$0 0130	508	64	9	2.0084
Animal-meal house, .	2,440	6 24	0025	0097	639	80	15	2.0270

There was, in addition to the eggs as shown by the table, one soft-shelled egg in each house. Two hens in the cut-bone house died during the experiment, from diarrhœa; those in the other house were healthy throughout the experiment.

The dry matter per egg was, where cut bone was fed, 0.877 pounds; on animal meal, 0.69 pounds. The number of sitters was 6 in the cut-bone house, 12 in the other.

A sample of eggs from each house was subjected to analysis. Those produced on the cut bone contained rather more protein but less fat than the other. A test for cooking quality was indecisive; one of the two house-keepers having preferred one lot; the other the opposite lot.

The advantage in this trial is, then, clearly with the animal meal as a food for egg-production. It has given more eggs of a greater average weight and at considerably less cost than the bone; and it is, moreover, a more convenient food to use, as well as safer. The results this year are thus the opposite of those of last year. We have now repeated this experiment four times, with results twice favorable to the bone and twice to the animal meal, but have not before found so decisive a difference as this year. We repeat the experiment again this winter.

3. *Clover Rowen v. Cabbage for Egg-production.*

Plymouth Rock pullets were used in this experiment; but they were later-hatched fowls than those in the experiments already described. There were twenty fowls in each

of the two houses, at the beginning. One fowl died in each house during the experiment, from unknown causes. The cut clover was fed in the morning mash. Instead of the clover, a fresh cabbage was kept before the fowls in the other house.

The foods used are shown in the table: —

KIND.	Clover House (Pounds).	Cabbage House (Pounds).
Wheat,	223	212
Oats,	150	149½
Bran,	28	36
Middlings,	28	36
Animal meal,	28	34¾
Clover,	26	-
Cabbage,	-	46¼
Cut bone,	8½	8½
Oat meal,	28	36

The nutritive ratio was practically the same in both houses: viz., in the clover house, 1 : 4.99; in the other, 1 : 4.838.

The average weights of the fowls were as follows: —

DATES.	Clover House (Pounds).	Cabbage House (Pounds).
January 4,	4.560	4.530
February 4,	5.480	4.800
March 8,	5.420	5.350
April 27,	5.470	5.394
May 3 (after twelve hours fasting),	5.289	5.184
Dressed weights,	4.780	4.890

The leading results and details are shown in the table:—

Clover Rowen v. Cabbage for Egg-production.

Experiment January 1 to May 2.	Number of Hen Days.	Gross Cost of Food.	Cost per Hen Day.	Cost of Food per Egg.	Number of Eggs.	Weight of Eggs.		Weight per Egg (Ounces).
						lbs.	oz.	
Clover house, . .	2,356	$7 033	$0 0029	$0 0150	466	59	10	2.0472
Cabbage house, . .	2,423	6 988	0028	0118	588	75	1	1.9990

In addition to these, the fowls in each house laid one soft-shelled egg.

The advantage lies most decidedly with the fowls fed cabbages, in so far as numbers, weight and cost of eggs are concerned. The eggs from the clover house were, however, much superior in cooking and eating quality to those from the other. Both house-keepers reporting are most emphatic in the expression of their preference for the eggs from the fowls fed the clover. One reports: "The eggs from the clover lot are in every way superior." The other says: "They are superior in color, size of yolk and flavor;" and adds that "they have the finest flavor of any eggs" she ever ate.

Analysis showed the eggs from the fowls fed cabbages to contain higher percentages of dry matter, protein and fat than the others. The superior richness of these eggs apparently renders them strong in flavor.

REPORT OF THE METEOROLOGIST.

JOHN E. OSTRANDER.

The work of the meteorological department during the past year has been in the main a continuation of that of previous years, with such minor changes as, after due consideration, have seemed advisable. The observations for temperature are now all taken in the ground shelter on the campus. The publication of the maximum and minimum temperatures taken in the observatory shelter was discontinued last year, owing to their unreliable character. For the same reason, the observations themselves were discontinued early in April the present year.

The usual bulletins, giving a summary of the records and weather for each month, have been published. An annual summary will be issued as soon as the records for the year are completed.

No material additions have been made to the equipment of the department during the year.

Arrangements have been made to furnish the New England Weather Bureau with the weekly snow reports, as was done last year.

In co-operation with Professor Whitney of the Division of Soils, United States Department of Agriculture, this department installed one of his instruments (kindly loaned by the Department at Washington) for the electrical determination of moisture in the soil. Observations were taken from the latter part of June until early in November. The records, however, are incomplete for the period, owing to breaks in the circuit and other causes which made the instruments fail to work at times. The readings taken were sent weekly to the Department at Washington. The Division of Foods and Feeding of this station made some

independent determinations of moisture for standardizing the instrument, and the Division of Botany kept a record of the growth of the crops where the electrodes were buried. Owing to the unusually wet weather during the summer and the incomplete records of the instrument, the results of the experiment were not entirely satisfactory. The department expects to repeat the observations next year under more favorable conditions, and an outfit for that purpose has been ordered.

It is hoped that arrangements may be made to put the electrometer in the tower in working order, so that observations on atmospheric electricity may be undertaken.

REPORT OF THE BOTANISTS.

GEORGE E. STONE, RALPH E. SMITH.

Our work during the past year has been in general a continuation of that of the year preceding. In this, as in other departments of the station, the work falls under two classes: first, examination of material sent in for determination and answering of inquiries; second, investigations of problems connected with plant physiology and pathology.

For the purpose of investigation the greenhouse has been remodelled and enlarged during the past summer, so as to admit of carrying on experiments under more desirable conditions. It is quite essential, in experimenting with plants, that the number employed should be large enough to make it possible to draw deductions from the results with a reasonable degree of certainty that errors arising from individual variation have been counterbalanced. It is also essential that the heat, light and moisture conditions should be equal upon each series of plants under consideration, and that these conditions should compare as closely as possible with the best method of cultivation. In the construction of the experiment house these details have been considered as carefully as possible. The house as now arranged consists of several sections, in which different temperatures can be maintained, for growing tomatoes, cucumbers, lettuce and other important plants subject to destructive diseases. The amount of money invested in the production of greenhouse crops is large and continually increasing, and no small part of our work consists in the study of the various diseases which affect them.

For the last three years we have been investigating methods of controlling the gall-forming nematode worm, which affects cucumbers, tomatoes, English violets, roses, cyclam-

ens and many other greenhouse plants. The results of the investigation are nearly ready for publication, but it seems desirable to first clear up a few remaining points upon the habits of the worm, which are not well known.

Experiments are also being made upon the different methods of pruning tomatoes, and upon the best light conditions for assimilation in greenhouse cucumbers.

With regard to lettuce we are studying the mechanical conditions of the soil as affecting the crop, and the various fungous diseases to which it is subject, more especially the disease known as the "drop."

In addition to these experiments, it may be mentioned that there are incidentally being carried on investigations upon the influence of electrical currents on the growth of plants. Bulletin 43 of this station embodied the most careful and extensive series of experiments ever made upon the subject. They were carried out by Mr. Asa S. Kinney, while a student at the college, and did not necessarily fall under station work. The results obtained by him were of such a promising nature that it has seemed well worth our time to carry the investigation further. It should be stated that any costly method of using electricity as an accelerator of plant development is not to be recommended. If, however, any simple and cheap means of using electric currents can be used, which will give an acceleration in the growth of a crop equal to 30–40 per cent., it might be worthy of consideration by practical agriculturists.

We have in progress a series of experiments with various gaseous substances, with a view to developing a treatment of this sort for combating fungous diseases of greenhouse plants. This method of treatment has been suggested by the extensive application which it has reached in exterminating insects. While we are as yet unable to present any results of great practical value, it is hoped that these experiments may lead to the development of an effective treatment for greenhouse plant diseases by the use of a gaseous substance. The great superiority of such method over that of spraying, which is in many cases inapplicable, needs no exposition. Our experiments thus far have been carried on

with two gases, hydrocyanic and formaldehyde. Neither of these appears to answer the purpose. The former, which has been found to be of considerable value as an insecticide, cannot be made effective as a fungicide without using a strength which will prove fatal to the plant. This we have determined by parallel exposures of various fungous spores and plants to the gas, and also by the fact that spores of the carnation rust, taken from plants which had been almost killed by over-exposure, germinated freely. Formaldehyde has a well-marked fungicidal effect, and is much less harmful to plants; but we cannot at present recommend it as a general fungicide, on account of the difficulty of producing it in sufficient strength.

The past year has been an exceedingly abnormal one for vegetation, and as a result this division has had many inquiries concerning plant diseases, different from those of ordinary years. The excessive and long-protracted rains and the lack of sunshine gave rise to a multiplicity of plant diseases such as we have not had for some years. This was the case not only in regard to our various crop plants, but our introduced ornamental species and even our wild plants were unusually affected by fungi. An unusual number of the so-called spot diseases made their appearance, and defoliated to a greater or less extent more than one species of tree. These spot diseases were especially disastrous to the sycamore and butternut, both of which in many instances lost all their foliage; while other trees, such as the chestnut and wild cherry, were more or less affected. The fungi causing these diseases are not new to these trees in this locality, but the abnormal conditions to which all vegetation was subjected proved amply sufficient to accelerate their growth and development.

Whenever the normal conditions surrounding the plant are disturbed, we must expect to find irregularities in its functions; and any serious irregularities in the plant's functions are most likely to manifest themselves by the presence of some insect, fungous or bacterial organism. Abnormal functions, or, in other words, physiological disorders, are in a majority of instances the basis of many plant diseases

with which gardeners have to contend; and, since we are liable to observe only the effects of the fungus or bacteria preying upon the plant, we too often think that they are the primary causes of the disease, when, as a matter of fact, they are purely secondary.

This leads us to the subject of spraying as a preventive of plant diseases. From the hap-hazard manner in which it is often resorted to, one would gain the idea that it is intended as a curative rather than as a preventive remedy. This idea is erroneous, inasmuch as spraying is intended as a prevention rather than a cure. This misconception of the proper use of spraying solutions gives rise to the practice of using the Bordeaux mixture as a panacea for every plant disease. Upon this point we wish to state that it must be distinctly borne in mind that spraying under any condition is only a temporary means of preventing certain diseases. The ultimate aim of all progress connected with gardening should be not only to improve the marketable product, but to improve the stock and increase our knowledge pertaining to proper cultivation, so that spraying will be unnecessary. Many experienced gardeners recognize this, and we find experts in almost every line of gardening who have had eminent success in controlling diseases without resorting to the use of fungicides. Some of the most experienced growers of carnations claim that they can control the many diseases which have of late years affected this plant, by simple, judicious methods in the management of the greenhouse.

To expect that spraying is going to save plants that are improperly cared for, or to act as a cure for those already diseased, is absurd. There are many instances where spraying produces beneficial results, and at the present time it appears to be essential, in some instances, to the production of good crops; but there are also many instances where it is entirely useless. This applies especially to the diseases having their origin in improper care or in abnormal conditions surrounding the plant. The condition of the potato crop in Massachusetts during the past summer affords an illustration of how any amount of spraying would not save

it from disease, when the soil was soaked with water and the plants in some instances practically submerged for days at a time. Every plant is surrounded by a host of parasitic organisms, which, given the proper conditions, will manifest their distinctive properties. The healthy, vigorous plant is always less susceptible to the attacks of fungi than the weakly, abnormally developed one, — a fact which every practical gardener readily understands. We have seen this illustrated so many times in our work in the greenhouse that it may be well to give an example of it here. Certain species of non-parasitic nematode worms, which are always present in greenhouse soil, although apparently doing no harm as long as the plants are vigorous, will, as soon as the plant becomes weakened or abnormal from any cause, penetrate the tissues and cause rapid decomposition of the same. What is true in regard to nematodes applies also to fungi and bacteria, and, indeed, these various forms of organisms are most frequently to be found together in the decayed tissues of the plant.

Before any attempt is made to spray diseased plants, it is well worth while to find out something about the nature of the disease with which the plants are affected. It is, for example, unwise to spray roses for the black spot or mildew when the roots are half decayed by the action of parasitic gall-forming nematode worms; and for the same reason it would be unwise to treat the spot disease of the English violet, when the roots are covered with hundreds of minute galls, and when the supply of nutriment from the root is greatly interfered with.

On the other hand, spraying the apple, grape, potato and plum is at the present time justifiable and necessary; and there are many diseases common to greenhouse cucumbers and tomatoes which can be largely controlled by spraying, although it must be said here that by judicious management of the various conditions surrounding the plants these diseases can be checked.

The Causes of the Failure of the Potato Crop of 1897.

The disastrous effect upon agricultural crops of the excessive rainfall of the past season has been especially marked upon the potato. The small yield and large amount of rotting of this staple may be easily attributed to this source. In all sections of the State, as well as beyond our borders, the report has been general of a small potato crop and excessive rotting. This rotting has been generally regarded as resulting from the well-known and ordinary "potato rot" fungus, Phytophthora infestans. In fact, however, we have to describe a series and variety of agents, which, under the favorable influence of the excessive rainfall, — an influence unfavorable to the vitality of the plant, — have brought about the diminution and destruction of the crop.

At planting time the ground was extremely wet. The crop, however, started well, and the plants appeared above ground in a promising manner. Continuous rains kept the soil saturated with moisture, and before the plants had reached a height of more than six inches it was noticed in many places — usually the lowest and wettest portions of the field — that many of them were dying. Such plants did not collapse suddenly, but gradually turned yellow and faded away, most of them dying eventually, though here and there one would be seen which maintained a feeble, stunted growth through the season. This was the case not only in this vicinity, but it was also reported from various parts of the State.

Investigation of affected plants showed that the trouble was due to a rotting of the stem of the young plant below ground, which rotting evidently proceeded from the seed potato, which was found in every case to be a putrid mass, while the decay was gradually extending up the young stem. Careful search for the cause of the rotting failed to reveal any particular organism to which it could be ascribed. That it was of bacterial origin seemed quite certain, as the decayed tissue swarmed with organisms of this class, while no fungus which could be considered the cause of the rotting

was found. In the cortex and exterior portions of decayed stems several forms of Micrococcus and also other bacteria were found in abundance. In the interior portions a large, motionless bacillus occurred quite abundantly and exclusively, and may have been the primary cause of the rotting. The most probable explanation, however, seems to be that the normal functions of the plant were disturbed and its growth checked by the unusual amount of moisture in the soil. The seed potato, with its supply of reserve food material for the young plant thus left idle in the soil, naturally rotted away, and this rotting communicated itself more or less to the young stem proceeding from the "seed." The plant, not being in a condition of vigorous growth to resist this rotting, gradually succumbed to it, and in most cases died. The few plants, as mentioned above, which continued a feeble growth through the season, accomplished this by throwing out roots above the rotted portion of the stem, and thus prolonged a feeble existence. Such plants produced no tubers, and consequently had no value whatever.

This, then, was the first of the troubles affecting the potato crop in this section. We do not describe or consider it as a specific "disease" of the potato, nor do we deem it necessary to consider any treatment for it. We at first recommended removing affected plants, but doubt now if such a course would have been of any considerable practical value. We are inclined to believe that the trouble was not brought about by any specific or especially destructive organism, but was simply the result of the unusual meteorological conditions of the season, and under such conditions could not be prevented from occurring by any means at our command.

By July 1, most of the plants which had fallen a prey to the above disease were withered away and dead, while those which had escaped had made a fairly good growth and nearly reached maturity in point of size. About July 15 several hot, sunny days came on, following a long very rainy spell. In many potato fields on low ground the plants began to wilt and die down. In a large field at the college, situated on a long slope, the plants at the top were un-

affected, but those in a limited area at the bottom of the slope—the wettest part of the field—began to wilt (see plate). Many had already died here from the effects of the first disease. It is a well-known fact that plants often wilt when exposed to strong sunlight after a continued cloudy and wet period, this being due to excessive evaporation or transpiration of water from the leaves. In this case, however, the wilting was too pronounced to be attributed to this simple physiological phenomenon. Investigation showed that the leaves were not "blighted" nor were they affected in any way except the simple wilting, which was evidently caused by some trouble at the root. Plants were then dug in various portions of the affected area, and in all stages of collapse, and their roots examined for the cause of the trouble. It was found that there was no one organism (except possibly bacteria) attacking the plant, but there was a general rotting, resulting from the wet condition of the soil and consequent low vitality of the plant. The features of this rotting varied greatly in different plants, however, and scarcely any two were affected in an exactly similar manner, it being almost impossible to specify a feature of the disease common to all, except the wilting of the tops. In the very wettest part of the affected area the tubers were rotting badly. These rotten tubers were swarming with bacteria, but they were of various kinds, and to no one could be ascribed the beginning of the trouble. Various species of fungi were found in some, but these were moulds and similar forms, and included nothing which by any probability could have caused the rotting. Since fungi were entirely absent in many of the rotten tubers, it is certain that they did not cause the trouble. In many cases the decay seemed to have started where a grub of some kind had eaten into the potato. On somewhat dryer ground, where the plants wilted, the tubers were not rotten. In many cases, however, the stem was found to be decayed just where it joins the root. The young rootlets were also rotting, so that the cortex fell away from the central portion. These symptoms also occurred, and more pronouncedly, in cases where the tubers were rotten. In

these decayed stems and roots no one organism could be found as the cause of the rotting. Bacteria (mostly micrococcus) swarmed in all affected parts, and several mould fungi also occurred. Quite noticeable on all affected plants was the occurrence on tubers and even on the base of the stem, of small, white, mealy dots, scattered abundantly over the surface. These were apparently enlarged lenticels, being composed of parenchymal cells breaking out at the surface. It seems probable, or is at least possible, that their production was due to the scarcity of air in the wet soil.

We can only conclude here, as in the other case, that this cannot be called a definite disease, but rather was the result of abnormal and unusual conditions. During the long-continued rain the living functions of the plant were disturbed and its growth checked. Various organisms then came in, and, gaining a foothold, so weakened it that when the sun came out it wilted down and in the worst cases died. Had it been possible to thoroughly cultivate and stir the soil at this time, it is reasonable to suppose that much of the trouble might have been averted; but the extreme wetness made such a course impossible.

This trouble came on after the potatoes had reached a marketable size. We therefore recommended digging them in all affected places, in order to save them from decay. Beyond this there could be no practical treatment suggested.

Early in August, or even sooner, the real potato blight or rot, Phytophthora infestans, began to appear, and developed very extensively during the month, killing the tops of potatoes everywhere, and causing great loss by rotting of the tubers. This disease is too well known to need extended description. Its ravages might probably have been controlled to some extent by thorough spraying throughout the season, but it would have been practically impossible to entirely prevent it in such a summer.

The "Drop" of Lettuce.

The loss represented by this disease frequently amounts to thousands of dollars in a single season in Massachusetts. Almost every lettuce grower has had more or less experi-

ence with it, although, as with every other disease, some have been much more affected than others. We have known several instances during the season where extensive growers have lost practically their whole crop, and, as a consequence, have become much discouraged with lettuce growing. Inasmuch as the general characteristics of this disease were given in the ninth annual report, it is not necessary to enter upon any minute description here. Suffice it to say that the disease makes its appearance in the stem, close to the surface of the ground, where the tissue becomes slimy and soft, and eventually the whole stem at this point disintegrates and collapses. This occurs most frequently just as the plants reach maturity.

The fungus causing this disease is well known to all greenhouse men. The "damping fungus" (Botrytis), which causes the drop, often gives rise to disastrous effects on begonia and other cuttings in the propagating pit. The fungus, however, as it appears upon the lettuce, presents some aspects which are different from its appearance upon cuttings, and reaches a more advanced stage of development. Our present knowledge in this direction possesses more of a technical than practical interest, although an understanding of the complete life history of the fungus will, no doubt, lend much aid to its rational treatment.

The natural conditions governing the development of the organism appear to be similar to those of most organisms, — that is, it requires the presence of oxygen. It is well known that almost any object when driven into the ground will undergo disintegration much more rapidly at the surface of the soil, for here the conditions of moisture, etc., are most favorable for the organisms producing disintegration. And so it is with the "drop" fungus; it finds just the conditions at the surface of the soil, under the moist, shady leaves of the mature lettuce plants, for its destructive work.

Our experiments upon the control of this fungus are by no means complete, but it will not be out of place here to offer some suggestions in regard to its general habits and the methods of treatment which may be tried. Probably

every grower has the germs of the disease in his lettuce soil to a greater or less extent, but the conditions giving rise to their excessive development are not always present. Some claim that manure is the principal source of infection; yet, on the other hand, while all use manure, all are not troubled in the same degree. As a remedy for the drop, some have resorted to the practice of sanding the surface of the soil or putting on a layer of yellow loam. This is for the purpose of giving a clean, uninfested surface to the soil surrounding the plants. In regard to the effect of this treatment, it may be stated that opinions differ considerably. Whether the method of applying a superficial layer of sand or subsoil to the surface will be of any assistance in keeping the drop in check appears somewhat doubtful, from an experiment made of burying some infested plants to a depth of three or four inches in a pot of yellow loam subsoil. It was found that the fungus made its way to the top in a very few days, as was evident from the mould-like growth of the mycelium upon the surface of the soil and the death by drop of plants which had been set in the pot. Neither can we expect much from the application of chemicals, as any such treatment would interfere with the growth of the plant, and hence become objectionable. Some experiments are now being made with gases, with the idea of killing the organism by fumigation; but this method does not promise much success.

The application of live steam to the soil, and thus sterilizing it, would undoubtedly destroy the germs of the disease. To do this would necessitate laying two-inch tile at a depth of eight inches or a foot below the surface of the soil, and at a distance of one or two feet apart, and driving in steam under pressure and allowing the same to permeate the soil. This method can be employed on a small scale with good results, but the larger area of a lettuce house would render its practical application uncertain. Another method of treatment by steam, which would be far cheaper, would be to sterilize the surface of the soil to a depth of three or four inches or more. This can be done by constructing a pit in the lettuce house and covering the bottom

with tile or one and one-half or two inch steam piping. The tile allows the steam to escape very readily; and, in order to get the best effect, they should be laid close together, say one foot, or less. In case steam pipes are used, — and they are probably more effective than tile, — they should be bored with holes every three or four inches, to allow the steam to escape. With an arrangement of this kind, one would be able to sterilize the soil in a few hours. A pit twenty feet long, ten feet wide and eighteen inches deep would hold sufficient soil to cover twelve hundred square feet of surface three inches deep. The time required to heat this earth up to 200° F. would be only a few hours. Of course the pressure of steam available, the closeness of the pipes and the number of outlets for the steam would largely determine the time necessary to heat the earth.

Various methods of treatment for this disease are being tried, to determine how it may be most effectually dealt with. In connection with the method of steam sterilization, which seems by far the most promising, it is especially desirable to ascertain just how deep the soil must be sterilized in order to keep down the fungus.

The Asparagus Rust.

(*Puccinia asparagi.* D. C.)

In the last annual report of this division attention was called to a new disease which had appeared upon the asparagus, and the apprehension expressed that it might come to be a serious matter. That apprehension has been more than justified. The asparagus rust, unknown to the growers of Massachusetts in 1895, slightly prevalent in 1896, has appeared everywhere during the past season, and bids fair to become a most important factor in the growing of this crop.

The disease first appeared in the fall of 1896, both in this State and in several others, but was not generally prevalent at that time, although in some fields it was very abundant. Cutting and burning infested tops was generally recommended and to some extent practiced; but the majority of asparagus growers had not as yet become acquainted with this new danger menacing their crops.

This rust, like the well-known one of the wheat, has three different stages or forms in its development, though in this case they are all developed upon the asparagus plant, while in the other, one form comes upon the barberry bush and the other two upon the wheat and other grains and grasses. When first noticed in 1896, the asparagus rust was in the fall stage, the black rust or *teleuto* stage, the earlier stages not having attracted attention. In 1897 many asparagus fields were found to be affected as early as July 1, and by August the complaint was general throughout the asparagus-growing sections of the State. It was now the red rust, or *uredo* form, which was present, being followed again in the fall by the black form. Apparently almost every field of asparagus in the State was affected before the end of the season. The rust in most cases appeared first on young beds, — which was natural to expect, since the stalks were not being continually cut off as they appeared. In the older beds, from which the stalks were being cut for market, little or no rust appeared until well into July or August, after cutting had been suspended and the tops allowed to develop. In most cases, however, they were soon affected as badly as any. The effect of the rusting was that the tops lost their green color, and turned brown and died prematurely. Mr. George P. Davis of Bedford says in regard to his beds: "The twenty-sixth of July the tops were all turned brown, and looked as though a fire had swept over the field. There was no green to be seen. . . . In handling the tops a fine dust which looked like smoke was quite noticeable." This dust consisted of countless numbers of the spores of the fungus.

The first attempts at checking the rust were made in the fall of 1896, and consisted of cutting and burning affected tops. When the disease appeared so extensively in 1897, many growers cut the tops in August, when they had become badly rusted. It is impossible to say with much certainty what the result of the first cutting (fall of 1896) may have been, inasmuch as comparatively few beds were thus treated or badly affected at that time. A good-sized bed at the college was considerably rusted, and the tops

were cut and burned late in the fall. The bed was well cultivated and fertilized, and no rust appeared upon it in 1897 (that is, not enough to be noticeable) until well into the fall, when the black rust stage was quite as abundant as it had been in 1896. Mr. S. T. Davis of Orleans also mentions having observed a small bed, which was cut in the fall of 1896, upon which no rust appeared in 1897. Whether the cutting of the tops or some other factor kept down the rust in these beds, we are not prepared to say. The cutting which was quite extensively practiced in the summer of 1897 seems to have been entirely without effect, as the rust appeared again just as badly on the second growth.

The experience of another season is necessary to demonstrate the actual effect and seriousness of this disease. Its perennial occurrence to the extent of the past season could not fail to have a disastrous effect upon the asparagus-growing industry. It is not the sort of disease which is effectually suppressed by spraying methods, though something of that sort may be developed if it becomes necessary.* It should be remembered, however, that the past season was an unusually favorable one for all fungous diseases, and consequently it may have developed much more extensively than it ordinarily would. If it could be mostly confined to its teleuto or black rust stage, which appears in the fall when the plants have practically completed their growth, it is not probable that any serious injury would result. At all events, the effect of the great prevalence of the rust in 1897 upon the asparagus crop of 1898 will be awaited with great interest by all interested in its cultivation.

The Fire Blight.

(*Micrococcus amylovirus.*)

This disease of the pear, quince, apple and other pomaceous trees has been the subject of frequent inquiry during the past season. It ordinarily causes the most damage on the pear and quince, and is one of the most destructive of plant

* Recent experiments indicate some amenability of the rust to spraying, although not more than twenty-five per cent. reduction is claimed.

diseases. The trouble appears in the branches, sometimes a whole limb of considerable size, but more often the smaller terminal twigs, being affected. These portions of the tree suddenly wilt and die, the leaves and young fruit turning black and hanging to the branches, producing the characteristic scorched appearance which gives the disease its name. It spreads rapidly about an orchard and increases from year to year, often involving the entire tree and causing its death if left unrestricted.

The cause of this trouble was long a matter of speculation, but it is now known to be a species of bacteria which gains access to the tissues of the tree and by its rapid multiplication therein causes great destruction. This disease cannot be reached by spraying, and the only remedy consists in severely cutting back all affected branches, or whole trees if badly affected. All such prunings should then be destroyed by burning. This cutting should be done whenever the disease is observed, but is especially advisable in the fall or late summer, when the trees should be carefully examined, to make sure that no diseased branches or twigs are left to perpetuate the disease over winter. As the disease affects the hawthorne (Cratægus), shad bush (Amelanchier) and mountain ash (Pirus Americana), as well as the cultivated fruits, it may spread from some of these wild trees to the latter, unless care is taken to prevent such contagion. It is not probable, however, that such infection is ordinarily at all extensive.

The Quince Rust.

(*Gymnosporangium clavipes* C. and P.)

The numerous inquiries which we have received during the past season concerning this not uncommon trouble, as well as our own observations, indicate that it has been unusually prevalent and destructive. The disease affects principally the fruit, but also the young wood, causing distortion and malformation in both cases. It is very conspicuous upon the affected quinces in midsummer, both from their distorted shape, and from the numerous white, tubular excrescences appearing upon their surface. These excres-

cences contain masses of the bright orange-yellow colored spores of the fungus which causes the disease. The fungus has a peculiar course of development. It not only exists in the form seen upon the quince, but has also another form or stage, living upon a different kind of plant and quite different in appearance. This stage of the fungus lives upon the red and white cedar and the juniper, and is one of the forms which produce upon those plants the abnormal growths popularly known as "cedar apples." These cedar apples are peculiar outgrowths upon the twigs of cedars and junipers, reaching their complete development in early spring. They are oftentimes regarded as the proper product of the tree, or as insect galls, — which ideas are equally incorrect. These growths begin to form in midsummer, developing as small excrescences upon the twigs and gradually increasing in size until winter, when they are nearly full grown. An "apple" consists at this stage of an abnormal mass of the cells of the tree, with the filaments of the fungus growing abundantly between them. Remaining thus over winter, the first warm, moist weather of spring starts it into further growth and development. Upon the surface of the affected wood numerous projections appear, of a conical shape, and composed of a yellow, gelatinous substance. These projections are composed of a mass of the fungous filaments and a gelatinous substance which they secrete. In them are produced the spores of this, the *teleuto* stage. These spores are composed of two cells and borne on long stalks. The sudden appearance of these peculiar growths on cedar trees just after a spring rain is often taken for the blossoming of the tree, but is in reality the fructification of the fungus parasitic upon it. The gelatinous appendages of the cedar "apples" soon dry up and wither away after the rain, but not until the teleuto spores contained in them have germinated and produced secondary reproductive bodies called *sporidia*. These are carried away in the air, and proceed to infect, not cedar trees, but quinces or one or two other related plants. Upon the surface of these they germinate and produce filaments which grow into the substance of the young fruit or stems, and by their presence there cause the

distortion in shape seen in affected specimens. Upon this host the fungus forms little pustules just beneath the surface, finally breaking out into the air as tubular projections. In these are formed the yellow spores of this stage, called *œcidia*. These spores are unable to infest quinces again, but upon cedar trees begin the development of a new generation of "apples," which will in turn produce teleuto spores the following spring.

Treatment. — It is not often that the damage caused by this disease is of great extent. Sometimes, however, it becomes sufficiently troublesome to make it worth while to attempt to repress it. It is evident that the most vulnerable point of the fungus causing the trouble lies in its inability to reproduce itself continuously upon the quince. The most direct method of treatment, therefore, is to exterminate all white and red cedars and junipers from the vicinity of the orchard, and cut off all affected parts of the fruit trees, or entirely destroy badly affected ones. This, for various reasons, however, may not always be possible or desirable. As to spraying methods, it has been found quite effective to spray with Bordeaux mixture two or three times during the spring, especially during or just after rainy weather, when the spores are being disseminated. It may also be possible sometimes to remove affected twigs of cedar and juniper trees before the spores have been produced.

This same fungus has also been unusually abundant during the past season upon the fruit of various species of Cratægus (hawthorne), accompanied by an equal abundance of the closely related species, Gymnosporangium globosum, upon the leaves. We have also noticed these or related species upon the fruit of the Japanese quince (Cydonia Japonica) and mountain ash (Pirus Americana).

The Brown Rot of Stone Fruits.

(*Monilia fructigena.* Pers.)

This well-known disease found in the past summer just the conditions suited to its best development, and the peach, plum and cherry crops suffered in consequence. The dis-

ease needs no description to those who have ever tried to raise any of the above-mentioned fruits. It appears in the summer, some time after the fruit has set, often just as it comes to maturity, or even earlier in the season, the time of its appearance depending a great deal upon the weather, a warm, rainy period being liable to bring it on at any time. Indeed, it does not always wait for the production of fruit upon which to make its attacks, but often develops upon the blossoms, causing them to abort, and spreading thence into the young twigs upon which they are borne, results in their death. Upon the fruit the rotting is almost always found to some extent at the time of ripening, and, as already mentioned, often occurs earlier in the season when the weather is favorable, i. e., warm and moist. At such times the greater part of the crop is sometimes destroyed. In cherries the chief damage is done upon the ripe fruit. In peaches and plums, which have a longer season of ripening, the young fruit is more frequently affected. Early peaches are considered more susceptible to the disease than the later varieties.

The cause of this disease is a mould-like fungus (a true parasite, nevertheless), which spreads its vegetative filaments through the affected fruit and thus causes its decay. Wet weather brings about the rotting of the fruit by favoring the growth of the fungus, not by its direct effect. Fruit which is affected begins to discolor and soften, and gradually dries up and shrivels into a shrunken mass about the stone. It often remains on the tree for months, especially in the peach. In the early stages of infection the surface becomes covered over with little grayish spots of a powdery, dusty nature. These are clusters of the spores of the fungus, produced in countless numbers on the ends of filaments from the inside of the fruit which have pushed out through the surface. These spores, which serve to reproduce the fungus, are extremely minute in size, so that *en masse* they appear as a fine dust. Being easily carried by the wind, they are spread far and wide, and may thus infect a large district in a few days, under favorable conditions. After becoming dry and hard the affected fruits cease producing

spores, but their period of harmfulness is not yet ended. After lying over winter in a dormant state, the fungus in them is again aroused to life by the warm rains of spring, and begins the production of spores which are ready to infect the crop about to be produced.

It has been thought practicable by some to exterminate or at least greatly reduce this disease by the destruction of all affected fruit and thus prevent the fungus from surviving through the winter. The variety of fruits upon which it can exist, however, and the practical hopelessness of accomplishing the destruction of any considerable proportion of it, together with the uncertainty of the fungus being altogether dependent upon the dormant stage found in the dried-up fruit for its existence over winter, make the success of this plan very doubtful. We would not, however, discourage the practice of removing and destroying the affected fruit, especially any remaining upon the trees over winter; for this may result in future decrease of the rotting, especially in isolated orchards or trees.

The usual methods of orchard spraying have been found to keep this disease in check to a considerable extent, though in favorable weather it will often sweep through an orchard, despite all precautions. The spraying should be begun early, and kept up through the season with considerable frequency, especially near the time when the fruit is maturing. For such spraying, Professor Maynard recommends the use of the ammoniacal copper carbonate or a weak solution of copper sulphate. Details in regard to the treatment of this disease may be found in Bulletin 44 of this station.

The Chrysanthemum Rust.

(*Puccinia Tanaceti*, S.)

In the last annual report a rust upon chrysanthemum leaves was described, this being, as far as known, the first published mention of such a disease. The specimens were sent by Mr. G. H. Hastings of Fitchburg, who had experienced heavy loss as the result of the rust. This was the only occurrence of the disease encountered during 1896.

This year it has appeared in many places, both in this and other States, occasioning considerable loss, as it is often very destructive to infected plants. It is not yet generally known, however, among those who cultivate the chrysanthemum, though we fear that it may be by another year. Judging from the history of many similar diseases (asparagus rust, carnation rust, hollyhock rust, etc.), it will not be surprising if a general epidemic of this disease occurs next year. It will be well worth while, therefore, for growers to take precautions for guarding against it as much as possible, especially those whose stock is already infected. Great care should be exercised to get cuttings from vigorous plants, unaffected by the rust; and it will no doubt be profitable in the end to spray them a few times during the summer with the Bordeaux mixture or potassium sulphide, using one ounce of the latter in two gallons of water, or stronger, if the leaves will stand it. Should the rust appear on the young plants, they should certainly be sprayed at once and at frequent intervals thereafter, and the affected plants removed and destroyed. It will be useless to try to save them as they are doomed to destruction, or at best will only attain a weak, sickly, worthless growth. When the plants are placed in the benches for the fall, great care should be taken that no rusty specimen goes in, else it may bring about the ruin of the entire lot. Further than these suggestions little more can be said about the disease until time shall have shown what its seriousness may be and to what extent it can be controlled.

There are several other diseases affecting the leaves of the chrysanthemum, so that some may be in doubt whether their plants are really infested with the rust. It causes discoloration of the leaves, like other less destructive diseases, but may be distinguished from them by its production of small pustules, of a dark-red, powdery substance, on the under side of the leaves, something as in the carnation rust. This red powder consists of the spores of the fungus, which reproduce and disseminate it.

A Disease of the Cultivated Geranium.

During the past summer there appeared upon the leaves of some geranium plants upon the college grounds a disease which appears to be different from anything heretofore described. The plants in question grew in a long border bed, and comprised several different varieties. Along the back edge of the bed, trees and low shrubbery hung over to a considerable extent, so that the plants in that portion were quite shaded, while those in front were exposed more directly to the sun. The disease came on in the latter part of July, during the rainy weather then prevailing. The leaves began to turn yellow in small spots, which gradually increased in size, the leaf tissue dying away at those points; thus the leaves soon became covered with dead spots of considerable size, and finally lost their vitality completely. The plants in the front of the bed were most affected, those in the shaded portion showing little or none of the disease. All varieties, as above mentioned, were equally affected. The plants were sprayed with the Bordeaux mixture, but with no apparent success. The same disease was brought to our notice in Northampton and also in the eastern part of the State.

The trouble appeared to be the result of the attack of some fungus, but investigation of the affected leaves failed to reveal any such organism. Neither was there any evidence of the presence of insects. Numerous bacteria, however, were found in all affected tissue, and appeared to be the cause of the spotting of the leaves. We do not consider this a genuine disease of the geranium, nor do we expect to find it occurring in the future. That the plants were in a condition of low vitality and hindered growth by reason of the excessive moisture, and hence were an easy prey to organisms which ordinarily would be unable to affect them, seems the most probable explanation. The futility of spraying to prevent such a disease becomes apparent when its real nature is revealed.

Some Leaf Blights of Native Trees.

During the past season several different kinds of trees have been so generally affected with certain leaf-attacking fungi as to become almost entirely defoliated before the end

of the summer. While of no great economic or practical importance, these attacks have been so marked and their effects so conspicuous that a brief description of the nature of the trouble may be of interest. The following diseases were generally prevalent wherever the host trees occurred, over the considerable portion of New England which we visited during the summer.

A Leaf Blight of the Sycamore or Buttonwood.

(*Glocosporium nervisequum* Fckl. Sacc)

Numerous inquiries reached us during the spring and early summer concerning the very prevalent and destructive blighting of the leaves of the sycamore tree (*Platanus occidentalis*). It is probable that every good-sized tree of this species in the State was attacked by the disease. The younger trees were apparently, for some unexplained reason, less susceptible. The trouble appeared in May, when the trees, which had just leaved out, appeared as if they had been nipped by a frost or scorched by fire. The leaves withered and turned brown, the new twigs were killed and many of the leaves fell to the ground. In this condition the trees lost all beauty, and became unsightly objects. This disease is not entirely new in this State, although it has never been so generally prevalent before. It was first described in Germany in 1848, and has been common in various parts of Europe since then. In this country it has occurred mostly within the last fifteen years. It first appeared in the District of Columbia, Ohio, Kentucky and other parts of the country south of here, but is now widespread.

The cause of this disease is a parasitic fungus, growing in the leaves and young twigs of the tree, and causing their death. Several other fungi are usually found in connection with the disease, and may have something to do in causing it. This disease is a very serious drain upon the vitality of the tree, and often results in its death. Its occurrence early in the season, however, favors the tree, since it has a chance to, and in fact does, produce a new crop of foliage to carry it through the season. This exhausts the tree, however, and if repeated for several seasons is likely to cause its death.

As to a remedy for this disease, there is little to say. Spraying with fungicides is not to be practically considered, on account of the size and small economic importance of the tree. Gathering and burning diseased branches and leaves might lessen the trouble somewhat; but, if the disease continues to prevail, it will probably be best in the end to dispense with the sycamore as an ornamental tree, and plant something else instead.

A Leaf Blight of the Butternut.

(*Glocosporium Juglandis* (Lib.) Mont.)

No fungous disease has been more noticeable throughout the State during the past season than this. It first became apparent in July, when butternut trees were noticed to be losing their foliage. Examination showed that the rapidly falling leaflets were covered with dead and discolored spots, and had lost their vitality. All trees were not affected in the same degree, as some were almost completely defoliated in August, while others were attacked later or lost their leaves more slowly. By October 1, however, it was almost or quite impossible to find a butternut tree which had not lost the greater part of its leaves.

The cause of the trouble is a fungus, which lives in spots in the leaf, killing the tissue at these points and gradually causing the death of the whole leaflet, so that it falls to the ground. The disease spreads rapidly from leaf to leaf and from tree to tree, and many trees are soon defoliated. It is a well-known fungus, but has been unusually abundant this year.

A Leaf Spot of the Chestnut.

(*Septoria ochroleuca* (B. and C.)

This is another disease, quite similar to those above described, which has been very prevalent this year. It first became noticeable in July, when the ground under chestnut trees was covered with fallen leaves. Upon these leaves the fungus manifested itself very prominently in small, round, dead spots, about one-eighth of an inch in diameter, scattered over the surface more or less abundantly. These spots are the points where the fungus has become estab-

lished and killed the tissue. The fungus, like all those causing these diseases, reproduces itself by spores, which are produced in minute cavities in the dead area, usually on the under side of the leaf. Almost all the leaves on affected trees become dotted over with the little dead spots, and most of them fall to the ground before their time, thus weakening the tree. The disease is not, however, an especially destructive one, except to the beauty of the tree.

A Leaf Spot of the Wild Black Cherry.

(*Septoria cerasina*, Pk.)

The well-known "shot-hole" fungus, which often causes extensive damage to the plum and cherry, has been exceedingly abundant this year upon the leaves of the wild black cherry (*Prunus serotina*), many trees being almost entirely leafless in August. This fungus attacks the leaves of plums and cherries of several species, producing dead spots upon them, and eventually causing their death. In connection with the wild cherry the disease has little economic importance, except as it may spread from that tree to cultivated species. On this account, the destruction of the wild cherry, so desirable for the repression of the black knot and tent caterpillar, is even more advisable.

BACTERIAL BLIGHT OF GERANIUM

QUINCE.

REPORT OF THE HORTICULTURIST.

SAMUEL T. MAYNARD.

The lines of work in this division the past season have been largely the same as for 1896.

Raspberry Seedlings.

The collection of raspberry seedlings, now three years old, produced a large crop of fruit the past season, and many most promising varieties were found among them. These seedlings were from the hybrid or purple-cap variety *Shaffer*. They produced a great variety of forms, from the black-cap type (*Rubus occidentalis*), the hybrid type of the parent, to some of the most beautiful forms of the red raspberry (*Rubus strigosus*) and to albino forms of both species. Careful records of the hardiness of cane, vigor of growth, time of ripening, productiveness and quality were made during the season, and at this time the plantation is a very handsome one.

Another collection of seedlings from the same source, but one year younger, also shows many interesting forms of growth.

Seedling Currants.

About three hundred seedling currant bushes two years old have made a good growth and show many interesting varieties.

Grape Seedlings.

The collection of seedling grapes, numbering some six hundred varieties, is very interesting. The growth has been very vigorous and healthy, and most of them are in a condition to yield enough fruit next season to determine some-

thing of their value. From the appearance of the foliage and the growth of vine we may look for a great variety of types of fruit.

Strawberry Seedlings.

This collection, numbering about four hundred varieties, is in a very fine condition, and some varieties have shown decided merits.

Named Kinds of Strawberries.

Many new varieties of strawberries of decided merit have been added to the collection. Many of the older varieties of little merit have been discarded, and the plots at this time never looked so well.

Strawberry Field.

The field crop is planted on the knoll south of the old farm buildings, and is in a remarkably good condition. This land is of a gravelly nature, but with a retentive subsoil of hardpan, which in an ordinarily moist season may be depended upon to produce a large crop of fruit, but in a very dry time suffers severely. The land slopes in such a manner that either the trench system or the spraying systems of irrigation or sub-irrigation can be employed in case of drought. Two reservoirs on the grounds are available for this purpose, and the three methods may be comparatively tested. A considerable quantity of two and one-half and two inch pipe on hand is available for this work. This need not be of any great expense, while its importance is very great, as no comparative results have ever been obtained that show whether any of the methods can be profitably employed, or which is the most valuable.

Variety Testing.

The value of the comparative tests of varieties of fruits, vegetables, flowers, etc., is often discussed. That it is a legitimate and important part of the work of the stations is shown in the demand made for the publications recording the results of such tests. When we consider the large number

of new varieties of fruits, vegetables, etc., offered to the public every year at high prices, with the claim of merits for them far above those of the standard sorts, and which the average grower cannot afford to buy and test, it is certain that the stations can save the people much loss and expense.

In the work of variety testing at this station in past years, the reports show that the new varieties reported as being the most valuable have been those that later were considered most valuable and were most largely grown by the commercial grower, while the varieties reported as having little or no value have been everywhere soon discarded by the growers who tested them. This work would be of much greater value, without doubt, if one or more sub-stations in different parts of the State could be established, where the same varieties could be tested under different conditions of soil and exposure.

The large number of new varieties of all kinds of fruit, vegetables, etc., being introduced every year, and generally with extravagant claims of merit, renders this work of the Experiment Station imperative, and the people should refuse to purchase such varieties until they have the endorsement of the stations of several States. A single season's trial of a variety is of very little value. It requires several years, at least, to prove the value of vegetables or even the more early maturing small fruits, while tree fruits require a much longer period.

Other Experiments.

Among the other experiments now under way may be mentioned the destruction of greenhouse insects by the use of hydrocyanic acid; the testing of the value and keeping qualities of some fifty-five varieties of celery; sub-irrigation in growing lettuce under glass; the use of different kinds of mulch for strawberries; methods of overcoming the asparagus rust; testing varieties of dwarf Lima beans, etc.

Reports will soon be made of the results of the variety tests of fruits, vegetables, etc.; the use of "Laurel Green" as an insecticide and fungicide; of arsenate of lead as an insecticide; and of other work done during the year.

REPORT OF THE CHEMIST.

DIVISION OF FOODS AND FEEDING.

J. B. Lindsey.
Assistants, E. B. Holland, F. W. Mossman, B. K. Jones, H. H. Roper.

Part I. — Laboratory Work.

Outline of Year's Work.

Part II. — Feeding Experiments and Dairy Studies.

Part I.

Extent of Chemical Work.

The work of the chemical laboratory connected with this department has very materially increased during the past year. There have been tested 150 samples of water, 197 samples of milk, 2 samples of oleomargarine, 1 sample of butter, 123 samples of miscellaneous substances. In addition to the above, which were sent to the station for examination, there have been analyzed 260 samples of milk and 388 samples of feed stuffs, in connection with experiments in progress by this and other divisions of the station, making a total of 1,147 substances which have passed through the laboratory within twelve months. There have also been carried on, for the Association of Official Agricultural Chemists, chemical investigations, relative to the meth-

ods best adapted for the estimation of starch in agricultural products. This has involved a great amount of chemical work, the extent of which it is impossible to express in mere figures.

Character of Chemical Work.

Water. — The analyses of water have been made by the same methods as heretofore, and with the same end in view, namely, to aid farmers and others in guarding against the danger arising from the use of waters coming from polluted springs and wells. Illness frequently occurs in the family, the cause of which it is often difficult to explain, until an examination of the water reveals its pollution with sink, privy, stable or other drainage. The waters tested show much the same condition as in former years; in round numbers, 15 per cent. could be pronounced excellent, 40 per cent. fair, 25 per cent. suspicious and 20 per cent. dangerous for drinking. Fully 50 per cent., therefore, were considered of a suspicious character. Three samples were found to contain lead, and had been known to have produced lead poisoning. We can only repeat the advice given in former years, in cautioning all who are obliged to depend upon wells and springs for their water supply to take every precaution to prevent any drainage from entering, and to keep the grounds about the well or spring free from all objectionable matter. Lead pipes should never be used to draw water through, especially if the water is free from mineral matter (soft).

Milk. — The most of the milk received at the station has been sent by farmers who ship their milk to Boston contractors. They had probably been notified by the contractors that their milk was below the Massachusetts standard,* and they wished to ascertain its exact quality, and what, if anything, could be done for its improvement. The larger part of this milk was found to contain 12 to 12.5 per cent. of solids and from 3.25 to 3.50 per cent. of fat, and was in all probability the unadulterated product of the cow. The contractor, however, because of the large amount of milk

* The Massachusetts standard calls for 13 per cent. solids and 3.70 per cent. fat, excepting during April, May, June, July and August, when but 12 per cent. solids and 3 per cent. fat are required.

offered, can afford to be particular, and desires only that up to, or above the legal standard. In such cases there is nothing for the farmer to do but to add some grade Jersey or Guernsey cows to his herd. It certainly would be a long step forward, if milk were sold not simply as milk, but with a guarantee of composition. Milk containing 11.5 per cent. solids and 3 per cent. of fat should surely bring less per quart than milk containing 12, 13 or 14 per cent. solids, and 3.25, 4 or 5 per cent. fat.

Cattle Feeds.—At its session of 1897, the State Legislature passed a law authorizing the inspection of feed stuffs. The work is being carried out by this department, and it is hoped that it will result in keeping out poor and adulterated material, and in keeping the regular articles of as constant a composition as possible. Considerable adulterated cotton-seed meal was found on the market during the early spring months. This material consisted of a mixture of hulls and meal, the former ground very fine in order to conceal its identity. The adulterated product contained from 22 to 30 per cent. of protein, while a prime meal should show from 40 to 45 per cent. Farmers were warned through the agricultural and daily papers of the presence of the adulterated article, and cautioned against its purchase. The result of this has been to produce a feeling of uncertainty and to restrict the use of the genuine article. To overcome this, the American Cotton Oil Company have placed a guarantee of composition upon every bag put out by them. It is hoped other manufacturers will follow this example. *Farmers should by all means give the preference to the guaranteed article.*

Other new feed stuffs are those put out by the H. O. Company, under the name of dairy, horse and poultry feeds. The feeding values of these feeds are being investigated. Varieties of oat feeds, being mixtures of oat hulls with more or less corn meal, are found in the market without name or guarantee. Farmers are cautioned against their purchase, for the reason that the price asked is, as a rule, considerably in excess of their feeding value.

Methods for the Determination of Starch.—The work undertaken for the Association of Official Chemists, already

alluded to, has been reported to them. While more work will be done along this line, it has been quite clearly demonstrated that the so-called Maercker and Reinke methods for the estimation of starch in agricultural products are faulty, and will give altogether too high results. The only method from which reasonably accurate results may be expected is the diastase or malt method,* and this method has been adopted by the official chemists in place of all others.

PART II.

EXPERIMENTS WITH PIGS.

Two experiments have been completed with pigs, and a third is now near completion. These experiments were designed to study the value of corn meal as compared with hominy and cerealine feeds for pork production, when fed in combination with skim-milk. Both these feeds are quite similar in composition. They consist of the hull, germ and more or less bran and starch removed from white corn, during the preparation of cracked hominy and cerealine flakes for human consumption. Cerealine is much more bulky than the hominy feed. These experiments will be published in detail later. It can be said, however, that pigs have made nearly, and in some cases fully, as good growth on these feeds as on an equal amount of corn meal.

SALT MARSH HAY.

A thorough investigation has been completed concerning the general character and feeding value of salt marsh hay. The results are being published in bulletin form. The practical conclusions, briefly stated, are as follows: —

The several varieties of salt hay have, ton for ton, from 10 to 17 per cent. less feeding value than average English hay. When 10 to 12 pounds of salt hay were fed daily, together with 7 or 8 pounds of grain and a bushel of ensilage, the ration produced within 2 to 5 per cent. as much milk and

* Sachsse's method can be used for estimating starch in commercial starch and in potatoes.

butter as an equal amount of English hay similarly combined.

Because of the less market value of salt as compared with English hay, rations containing the salt hay, as given above, produced milk and butter from 10 to 20 per cent. less than did rations containing English hay. No objectionable flavor was noticed when the salt hay was fed directly after milking.

It is undoubtedly wise for farmers living near the salt marshes to feed salt hay and sell English hay. For the results in detail, and a fuller discussion, see the bulletin.

Digestion Experiments.

During the past year we have studied the amount of actual nutriment in salt hays, to which reference has already been made, in a number of new by-products and in green crops for soiling. Many of our results, together with practical conclusions therefrom, will soon be ready for publication.

COTTON-SEED FEED AS A HAY SUBSTITUTE FOR MILCH COWS.

J. B. LINDSEY, E. B. HOLLAND AND B. K. JONES.

The Experiment concisely described.

What Cotton-seed Feed is. — The seeds of the cotton plant are irregular, egg-shaped in form, and almost hidden by a tuft of white fibre which covers their surface. The meat of the seed is covered with a thick, tough hull of a black color. Machines have been invented to remove this hull, and the meat is subjected to warm pressure for the purpose of removing as much as possible of the oil. The pressed meat or cake is ground, and results in the decorticated, bright yellow cotton-seed meal of commerce. The black hull, covered with the white fibre, was formerly almost entirely used as fuel, and the ashes were sold for fertilizing purposes. Of late many southern farmers, at the recommendation of experiment stations in the south, have been mixing these hulls with the cotton-seed meal and feeding them to beef and dairy cattle, with very good success. Within the last few years this material, under the name of *cotton-seed feed*, has been offered in our Massachusetts markets. The manufacturers claim that the feed consists of 1,600 pounds of hull and 400 pounds of meal, thoroughly mixed by machinery. The price charged has been $13 per ton in car lots, delivered in Massachusetts, which would be equivalent to at least $15 in single tons. The feed, shipped in bags, is quite bulky, and, because of the white fibre covering the hull, looks somewhat like wool waste. Its color is light yellow, due to the admixture of the cotton-seed meal.

The Experiments briefly stated.

The experiment station has conducted four experiments with this feed, two with milch cows and two with sheep.

The feed for the first experiment was furnished by the manufacturers. In the second experiment we procured the separate ingredients, and mixed the feed ourselves. Each of the two milk experiments was made with six cows. In the first experiment the feed consisted of a constant grain and ensilage ration, together with a good quality of first-cut hay and cotton-seed feed; in the second experiment there was a constant grain and mangel ration, in addition to the hay and cotton-seed feed. The cotton-seed feed was looked upon as being similar in character to hay, and, in attempting to get at its value, from 12 to 15 pounds were substituted daily for a like quantity of hay. The first experiment lasted twenty-one days and the second twenty-eight days. In case of digestion experiments, in which six single tests were made, some of the sheep received nothing but the cotton-seed feed, and others received half hay and half of the feed. While the cotton-seed feed has not an attractive appearance, the animals in all cases ate their daily rations with no apparent objections.

The Results.

I. The total average gain of the six cows in live weight during the cotton-seed period was 95 pounds, and during the hay period 166 pounds.

II. The production of milk, milk solids and butter fat was so nearly alike in the average of both experiments as to be within the limits of experimental error.

III. The cost of producing milk and butter with the hay and with the cotton-seed ration varied but very little.

IV. A ton of cotton-seed feed contained about 964 pounds of digestible matter, and a ton of the hay about 1,007 pounds of digestible material.

V. A full description of the experiments, together with all data bearing on the results, will be found further on.

Is Cotton-seed Feed economical for Massachusetts Farmers?

There would unquestionably be no advantage for the average farmer to feed this material in place of hay, unless he could sell his hay for a sufficient advance over the cost of

the feed to warrant the change. Milkmen in the vicinity of large cities, and others who are obliged to purchase their coarse feed, might find it to their advantage to use some of this material, especially if it could be bought for less than a good quality of hay. It is possible that animals would tire of this feed sooner than of hay. The cows used by the station consumed it continuously for over a month with no seeming objections. The cotton-seed feed must be looked upon from a feeding stand-point in the light of a hay substitute, and not as a grain feed, and only 8 to 10 pounds should be fed each animal daily, in place of a like amount of hay or other coarse fodder. Southern rather than northern farmers can utilize cotton-seed feed to the best advantage.

The Experiments in Detail.

In 1889 Stone * records the fact that increasing quantities of cotton-seed hulls and various mixtures of hulls and cotton-seed meal were being fed by the farmers of the south for beef and milk production. Since 1889 a great variety of digestion and beef-producing experiments have been made by the North Carolina station,† which have been productive of a large amount of information relative to the physiological and economic value of cotton-seed feed. The Texas experiment station ‡ has made experiments with milch cows to study the economic value of this feed in a variety of fodder rations.

In 1894 Armsby § published the results of two experiments with cotton-seed feed. In the first experiment the cows, five in number, were fed as follows: Ration I. consisted daily of 7.95 pounds of wheat bran and 11.69 pounds of cotton-seed feed; while Ration II. contained 3 pounds of cotton-seed meal, 7 pounds of corn meal, 6 pounds of corn fodder and 3.27 pounds of hay. Practically, the corn meal and cotton-seed meal of the second ration were matched against the bran, and cotton-seed meal contained in the cotton-seed feed of the first ration, leaving the corn fodder

* Tennessee Experiment Station, Vol. II., No. 3, 1889.
† Bulletins 80*c*, 81, 87*d*, 93, 97, 106, 109, 118.
‡ Bulletin 33, 1894.
§ Report Pennsylvania Experiment Station, page 44, 1894.

and hay to be compared with about the same quantity of cotton hulls. The results, as would naturally be expected, were in favor of Ration II. This latter ration contained also 4 pounds more of digestible matter. In the second trial, six cows were each given daily 6 pounds of Buffalo gluten feed and 2 pounds of wheat bran. Ration I. contained in addition 10.6 pounds of cotton-seed feed, and Ration II. 4 pounds of corn meal and 9.7 pounds of clover hay. It is not possible to regard this as a fair comparison, for any one can see at a glance that 4 pounds of corn meal and 9.7 pounds of clover hay (13.7 pounds) must give better results than 10.6 pounds of cotton-seed feed. At least a fairer comparison would have been to have matched the cotton-seed feed against a like quantity of clover hay. Simply because cotton-seed feed consists of a mixture of cotton-seed hulls with cotton-seed meal, it is not at all necessary when making a comparison to put the like amount of cotton-seed meal or other grain into the opposite ration. By so doing, one simply compares cotton-seed hulls with some other fodder or fodder combination. The hulls themselves have an inferior nutritive value; experiments have demonstrated that their nutritive effect is increased by the addition of the cotton-seed meal. In order, therefore, to get at the feeding value of this material, it must be regarded as a single feed stuff, and ought to be compared with other coarse fodders of similar composition. It has been the aim of the experimenter, in the two experiments that follow, to make such a comparison.

A. Composition of Cotton-seed Feed.

The first lot of feed, supplied through the kindness of Mr. H. C. Haskell of the Southern Cotton Oil Company of Savannah, Ga., was said to have been mixed in the proportion of 1,600 pounds of hulls to 400 pounds of meal. The lot for the second experiment we prepared ourselves, in the same proportion. The two lots varied very little in moisture, but, for the sake of more exact comparison, the results are presented in dry matter.

	No. 1 (Per Cent.).	No. 2 (Per Cent.).	Theoretical Protein Content of No. 2 (Per Cent.).	Composition of Two Samples of Hay fed in the Two Experiments (Per Cent.). I.	II.
Ash, . . .	3.82	3.51	-	5.94	5.78
Protein, . .	13.02	11.98	13.85	11.07	8.41
Fibre, . . .	39.67	40.69	-	32.00	33.98
Extract matter, .	39.59	40.13	-	47.92	49.15
Fat, . . .	3.90	3.69	-	3.07	2.68

Both Nos. 1 and 2 run rather below the theoretical percentage of protein. This is not surprising, from the fact that it is extremely difficult to get a strictly average sample of this feed. It is impossible to grind the hulls fine, and in spite of all one can do, more or less of the meal will fall through the hulls and not be included in the sample. It will be noted that the cotton-seed feed and the hay resemble each other in chemical composition, excepting that the cotton-seed feed contains somewhat more fibre and less extract matter.

B. Digestibility of Cotton-seed Feed.

Recognizing the valuable information secured by digestion tests, six single trials with sheep were made of the two samples of feed. The sheep were grade Southdown mature wethers. In four cases the cotton-seed feed was fed alone, and in the remaining two the daily ration consisted of one-half hay and one-half cotton-seed feed. In both cases the results agree quite closely, except in case of the fat, which showed a digestibility of 98 per cent. when the cotton-seed feed was fed in connection with hay. This high result it was thought best to exclude from the average. The cotton-seed feed appeared to agree better with the sheep when fed in connection with hay than when fed by itself. In the latter case, at the close of the period the sheep began to show signs of diges-

tion disturbances, which would certainly have become quite pronounced had the feeding been continued much longer. The digestibility of the two different samples of cotton-seed feed was practically the same. The North Carolina station has made a very extended study of the digestibility of hulls and meal fed in different proportions. The Pennsylvania station has also made three single determinations. These results, in addition to our own, are tabulated below:—

Digestion Coefficients.

	Proportions fed.	Number Single Determinations.	Dry Matter (Per Cent.).	Protein (Per Cent.).	Fibre (Per Cent.).	Extract Matter (Per Cent.).	Fat (Per Cent.).
Massachusetts station,	4-1	6	56	41	56	59	92
North Carolina station,	6-1	2	46	46	40	50	82
North Carolina station,	4-1	2	54	54	45	58	85
North Carolina station,	3-1 1½-1	9	54	64	47	54	85
Pennsylvania station,	5-1	3	43	36	31	54	84
Hay of mixed grasses with ten per cent. protein for comparison.	-	-	58	58	60	59	48

The experiments made by the North Carolina station (4–1) and by the Pennsylvania station were carried out with steers. The only difference between the results obtained by the Massachusetts station and those recorded by the North Carolina station (4–1) consists in the higher percentage of protein and the lower percentage of fibre digested by the steers in the North Carolina experiments. The coefficients for fat digestibility also show some variation, but, the fat percentage being comparatively small, the difference is not of so much account. The coefficients obtained by Armsby are lower than would be expected. The coefficients of digestibility for an extra quality of hay are not very noticeably higher — excepting the protein — than those for the cotton-seed feed.

According to the average coefficients of digestibility, a ton of the hay and a ton of the cotton-seed feed fed in the

milk experiments would contain the following amounts of digestible organic nutrients : —

One ton hay, ...	1,007.3
One ton cotton-seed feed, ...	964.4

One would therefore suppose that a ton of cotton-seed feed would have nearly the same feeding value as a like quantity of hay. There might be one exception to the above statement, in that it is possible that rather more energy would be required to digest the cotton-seed feed than the hay.

C. Milk Experiments with Cotton-seed Feed.

Experiment I.

This experiment was conducted during April and May, 1896. The animals, six in number, were evenly divided into two lots. In order to counteract the natural milk shrinkage, three of the animals in the first half of the experiment were fed the cotton-seed feed ration, while the other three were having the hay ration. In the second half this order was reversed. Each half of the experiment lasted twenty-one days, and from seven to ten days were allowed between the halves.

History of the Cows.

NAME.	Breed.	Age (Years).	Last Calf dropped.	Number of Days with Calf.	Milk Yield at Beginning of Experiment (Pounds).
Ada, . .	Grade Ayrshire,	7	Oct. 1	106	19
Red Spot, .	Grade Durham, .	6	Sept. –	90	21
Bessie, .	Grade Ayrshire,	7	Sept. 10	69	25
Beauty, .	Grade Jersey, .	5	Sept. 15	96	20
Red, . .	Grade Durham, .	7	Oct. 8	141	20
Spot, . .	Grade Durham, .	7	Oct. 8	141	20

Five of the above cows had been in two previous experiments since October, 1895.

Dates of the Experiment.

	Cotton-seed Ration.	Hay Ration.
April 8 through April 28, . . .	Cows 3, 4, 5	Cows 1, 2, 6
May 11 through May 31, . . .	Cows 1, 2, 6	Cows 3, 4, 5

Rations consumed Daily (Pounds).

PERIOD.	Name.	Hay.	Cotton-seed Feed.	Wheat Bran.	Peoria Gluten Feed.	Linseed Meal.	Millet and Soy Bean Ensilage.
Cotton-seed feed.	Ada, . .	–	10	2	3	1	15
	Red Spot, .	–	13	3	2	2	20
	Bessie, . .	–	15	3	2	2	20
	Beauty, . .	–	15	3	2	2	20
	Red,. . .	–	15	3	2	2	20
	Spot, . .	–	13	3	2	2	20
Hay.	Ada, . .	10	–	2	3	1	15
	Red Spot, .	13	–	3	2	2	20
	Bessie, . .	15	–	3	2	2	20
	Beauty, . .	15	–	3	2	2	20
	Red,. . .	14.2	–	3	2	2	20
	Spot, . .	13	–	3	2	2	20
Average cotton-seed feed.		–	13.5	2.83	2.17	1.83	19.17
Average hay, . .		13.47	–	2.83	2.17	1.83	19.17

Although but three of the six cows received the same ration at the same time, each animal received during the experiment the two different rations for exactly the same length of time. It will be observed that the only difference between the rations consists in the substitution of the cotton-

seed feed for the hay, and *vice versa*. The entire rations were eaten clean, excepting a small amount of hay refused by Red, which was preserved, analyzed and deducted from the total fed. The feeds were weighed out daily and given in two portions. Water was before the animals constantly. The cows were carded daily, and allowed the run of a yard in pleasant weather.

Digestible Nutrients in Daily Rations (Pounds).

PERIOD.	Name.	Total Dry Matter.	Digestible.				Nutritive Ratio.
			Protein.	Carbohydrates.	Fat.	Total.	
Cotton-seed feed	Ada,	17.36	1.77	8.30	.67	10.74	1:5.63
	Red Spot,	21.88	2.23	10.10	.82	13.15	1:5.45
	Bessie,	23.42	2.31	.10.82	.86	13.99	1:5.61
	Beauty,	23.42	2.31	10.82	.86	13.99	1:5.61
	Red,	23.42	2.31	10.82	.86	13.99	1:5.61
	Spot,	21.88	2.23	10.10	.82	13.15	1:5.45
Hay	Ada,	17.30	1.92	8.74	.50	11.16	1:5.20
	Red Spot,	21.81	2.42	10.70	.59	13.71	1:5.03
	Bessie,	23.90	2.57	11.05	.64	14.26	1:4.92
	Beauty,	23.90	2.57	11.05	.64	14.26	1:4.92
	Red,	23.19	2.53	10.72	.63	13.88	1:4.86
	Spot,	21.81	2.42	10.70	.59	13.71	1:5.03
Average cotton-seed feed.		21.89	2.19	10.16	.82	13.17	1:5.56
Average hay,		21.99	2.41	10.49	.60	13.50	1:4.99

The coefficients of digestibility for the cotton-seed feed and for the hay used in calculating the above digestible nutrients were those obtained in our experiments with sheep. Average coefficients were used for the grain feeds. The above results show but little variation in the digestible amounts of the several groups contained in the two rations.

Weight of Animals at Beginning and End of Experiment (Pounds).

		Ada.	Red Spot.	Bessie.	Beauty.	Red.	Spot.	Total Herd Gain.
Cotton-seed period, .	Beginning, . .	771	891	796	937	1010	967	19
	End, . . .	771	888	792	928	1025	977	
Hay period, . . .	Beginning, . .	775	892	861	1000	1070	965	40
	End, . . .	775	902	855	1012	1082	977	

Two weights were taken of each animal at the beginning and two at the end of the experiment. No marked variations were noted due to the influence of either ration.

Yield of Milk and Butter.

PERIOD.	Cows.	Total Yield of Milk (Pounds).	Daily Yield of Milk (Pounds).	Daily Yield of Milk (Quarts).	Total Milk Solids (Pounds).	Total Butter Fat (Pounds).	Total Butter (Pounds).	Daily Yield of Butter (Pounds).
Cotton-seed Feed.	Ada, ...	395.48	18.83	8.76	54.60	19.53	22.78	1.08
	Red Spot, . .	439.12	20.91	9.72	62.58	22.89	26.70	1.27
	Bessie, . . .	542.11	25.71	11.96	73.50	26.67	31.11	1.48
	Beauty, . . .	444.00	21.14	9.83	66.99	24.99	29.15	1.39
	Red, ...	416.62	19.82	9.22	58.38	21.00	24.50	1.17
	Spot, ...	337.25	16.06	7.47	50.82	18.27	21.31	1.01
Hay.	Ada, ...	402.71	19.18	8.92	54.60	18.60	21.70	1.03
	Red Spot, . .	458.75	21.84	10.16	64.05	21.29	24.84	1.11
	Bessie, . . .	526.86	25.09	11.67	70.35	23.81	27.78	1.32
	Beauty, . . .	399.89	19.04	8.86	58.17	20.35	23.74	1.13
	Red, ...	275.50	13.12	6.43	38.22	12.84	14.98	.71
	Spot, ...	419.50	19.98	9.29	61.58	22.11	25.80	1.23
Total cotton-seed feed, .		2,574.58	122.47	56.96	366.87	133.33	155.55	7.40
Total hay, ...		2,483.21	118.25	55.33	346.92	119.00	138.84	6.60
Percentage increase cotton-seed feed over hay.		3.6+	-	-	5.44+	10.76+	-	-

The cotton-seed feed ration gave a slightly larger amount of milk than the hay ration. A 5.4 percentage increase in the amount of total solids is also noted, while fully ten per

cent. more butter fat was produced by the cotton-seed ration. This latter result could hardly have been expected. Should cotton-seed feed exert a favorable influence in increasing the relative amount of butter fat in the milk, other experiments would show similar results, which we shall presently show has not been the case. A part of the decrease in the amount of milk, solids and fat produced by the hay ration can be accounted for in the sudden shrinkage of Cow V. (Red) in the second (hay) period. This cow was a grade Durham, and at the beginning of her second period was about 105 days from calving time. She began then to dry off rapidly, showing a shrinkage of 34 per cent. in yield of milk from that produced in the previous period, while other animals shrank only from 5, to in one case 20 per cent. Had Red shrank only 20 per cent., the total decrease in milk yield in the hay period would have been but a trifle over 1 per cent. The results of this experiment make rather more of a favorable showing for the cotton-seed feed than one would naturally expect, judging from its composition and digestibility. Before, therefore, drawing positive conclusions, the reader is referred to the results of a second experiment, described further on.

Dry and Digestible Matter required to produce Milk and Butter (Per Cent.).

Dry Matter required to Produce —	Cotton-seed Period.	Hay Period.	Digestible Matter required to produce —	Cotton-seed Period.	Hay Period.
100 pounds milk, . .	107.10	111.56	100 pounds milk, .	64.40	68.49
1 pound milk solids, .	7.52	7.98	1 pound milk solids, .	4.52	4.90
1 pound milk fat, . .	20.69	23.27	1 pound milk fat, .	12.44	14.28
1 pound butter, . .	17.75	19.99	1 pound butter, . .	10.68	12.27

Market Cost of Feed Stuffs.

Wheat bran, ...	$15 00	per ton.
Peoria gluten feed, ...	15 00	"
Linseed meal, ...	20 00	"
Millet and soya bean ensilage, . .	3 50	"
Hay, ...	15 00	"
Cotton-seed feed, ...	15 00	"

With the above figures as a basis, we obtain the following figures for the cost of feed required to produce milk and butter: —

	COWS.	Daily Feed (Cents).	100 Pounds Milk (Cents).	Quart of Milk (Cents).	Pound Butter Fat (Cents).	Pound Butter (Cents).
Cotton-seed period.	Ada, . . .	14.87	79.00	1.69	15.99	13.77
	Red Spot, . .	19.00	90.90	1.95	17.43	15.00
	Bessie, . . .	20.50	79.70	1.71	16.14	13.85
	Beauty, . . .	20.50	97.00	2.08	17.23	14.03
	Red, . . .	20.50	103.40	2.22	20.50	17.52
	Spot, . . .	19.00	118.20	2.54	21.84	18.81
Hay period.	Ada, . . .	14.87	77.50	1.67	16.71	14.43
	Red Spot, . .	19.00	87.00	1.87	18.81	16.10
	Bessie, . . .	20.50	81.70	1.76	18.14	15.53
	Beauty, . . .	20.50	107.60	2.31	21.13	18.14
	Red, . . .	19.90	151.70	3.09	32.62	28.03
	Spot, . . .	19.00	95.00	2.05	18.09	15.45
Average cotton-seed feed period.		19.06	94.70	2.03	18.19	15.49
Average hay period, .		18.96	100.10	2.12	20.92	17.94

The two rations costing the same, the cost of producing milk and butter was rather favorable to the cotton-seed feed ration.

Experiment II. (1896).

In view of the results obtained in the first experiment, it was thought advisable to conduct a second under practically the same conditions. The six cows were all approximately fresh in milk. The experiment was carried out in exactly the same way as the preceding one.

History of Cows.

NAME.	Breed.	Age (Years).	Last Calf Dropped.
Mary,	Grade Jersey,	9	July 1.
Jennie,	Grade Guernsey,	6	September.
Nora,	Grade Jersey,	10	August 23.
Beauty,	Grade Jersey,	6	September 15.
Red,	Grade Durham,	8	August 20.
Spot,	Grade Durham,	8	August 17.

The cows were farrow at the beginning of the experiment, and all were served during the progress of the trial.

Dates of the Experiment.

	Cotton-seed Period.	Hay Period.
October 6 through November 3,	Cows 1, 2, 5.	Cows 3, 4, 6.
November 17 through December 15,	Cows 3, 4, 6.	Cows 1, 2, 5.

Rations eaten Per Day (Pounds).

	NAME.	Hay.	Cotton-seed Feed.	Mangolds.	Wheat Bran.	Chicago Gluten Meal.
Cotton-seed period.	Mary,	2	15	15	5	3
	Jennie,	3	12	15	5	3
	Nora,	–	15	15	5	3
	Beauty,	5	15	15	5	3
	Red,	3	15	15	5	3
	Spot,	3	14.46	15	5	3

Rations eaten Per Day (Pounds) — Concluded.

	NAME.	Hay.	Cotton-seed Feed.	Mangolds.	Wheat Bran.	Chicago Gluten Meal.
Hay period.	Mary,	17	–	15	5	3
	Jennie,	15	–	15	5	3
	Nora,	15	–	15	5	3
	Beauty,	20	–	15	5	3
	Red,	18	–	15	5	3
	Spot,	18	–	15	5	3
Average cotton-seed feed period.		2.68	14.41	15	5	3
Average hay period,		17.17	–	15	5	3

It was not considered advisable to feed more than from 12 to 15 pounds of the cotton-seed feed daily, and the additional quantity of coarse fodder was secured by adding from 2 to 5 pounds of hay, to suit the appetites of the various animals. We have, then, 12 to 15 pounds of cotton-seed feed, compared with a like amount of hay. The cotton-seed feed was mixed daily in the proportion of 4 pounds of hulls to 1 pound of meal. The hay was a mixture of grasses, with Timothy predominating. Some clover was scattered through the mixture.

Digestible Matter in Rations (Per Cent.).

	NAME.	Total Dry Matter.	Digestible. Protein.	Digestible. Carbohydrates.	Digestible. Fat.	Digestible. Total.	Nutritive Ratio.
Cotton-seed period	Mary,	23.20	2.45	10.58	.83	13.86	1:5.08
	Jennie,	21.44	2.37	9.78	.76	12.91	1:4.85
	Nora,	21.44	2.37	9.76	.81	12.94	1:4.85
	Beauty,	25.83	2.57	11.82	.87	15.26	1:5.36
	Red,	24.07	2.49	10.99	.85	14.33	1:5.60
	Spot,	23.61	2.47	10.77	.83	14.07	1:5.08

Digestible Matter in Rations (Per Cent.) — Concluded.

	NAME.	Total Dry Matter.	DIGESTIBLE. Protein.	Carbohydrates.	Fat.	Total.	Nutritive Ratio.
Hay period.	Mary,	23.17	2.41	10.67	.56	13.64	1:4.95
	Jennie,	21.42	2.33	9.85	.54	12.72	1:4.77
	Nora,	21.42	2.33	9.85	.54	12.72	1:4.77
	Beauty,	25.78	2.53	11.91	.60	15.04	1:4.30
	Red,	24.08	2.45	11.08	.58	14.11	1:5.00
	Spot,	24.08	2.45	11.08	.58	14.11	1:5.00
Average cotton-seed feed period.		23.26	2.45	10.62	.82	13.64	1:5.14
Average hay period,		23.32	2.42	10.74	.57	13.72	1:5.00

The amounts and proportions of digestible matter in each of the two rations are identical. In calculating the above rations, average digestion coefficients were taken for the grains, the coefficients obtained at this station for the cotton-seed feed, and in case of the hay, the coefficients obtained by us for hay of similar appearance and composition. It must be remembered that the above digestible material in the two rations is only estimated. It is therefore quite possible that, had actual digestion experiments been made with the cows, these figures may have been somewhat modified.

Weight of Animals at Beginning and End of Experiment (Pounds).

		Mary.	Jennie.	Nora.	Beauty.	Red.	Spot.	Total Gain.
Cotton-seed period,	Beginning,	768	818	745	943	1,006	1,007	-
	End,	767	840	767	954	1,042	1,002	85
Hay period,	Beginning,	829	897	757	946	1,096	954	-
	End,	825	888	780	973	1,115	1,024	126

The cows were weighed at the same time for three consecutive days at the beginning and end of the experiment.

Four of the six cows were rather thin in flesh at the beginning of the test, and made gains on both rations. The hay period showed a herd increase of 41 pounds over the cotton-seed period.

Milk and Butter Yields (Pounds).

PERIOD.	Cows.	Total Milk.	Daily Milk.	Daily Quarts.	Total Milk Solids.	Total Fat.	Total Butter.	Daily Butter.
Cotton-seed period.	Mary,	596.88	21.32	9.92	83.38	28.29	33.00	1.18
	Jennie,	609.97	21.78	10.13	88.81	30.50	35.59	1.27
	Nora,	519.12	18.54	8.62	69.81	23.62	27.56	.98
	Beauty,	587.68	20.99	9.76	84.75	30.97	36.13	1.29
	Red,	549.94	19.64	9.13	67.63	21.28	24.82	.88
	Spot,	428.77	15.31	7.12	62.23	22.42	26.16	.93
Hay period.	Mary,	575.64	20.55	9.57	79.83	27.34	31.90	1.14
	Jennie,	527.12	18.82	8.75	80.49	30.46	35.54	1.27
	Nora,	613.34	21.89	10.17	80.77	24.78	28.91	1.03
	Beauty,	685.67	24.47	11.38	97.85	33.60	39.20	1.40
	Red,	557.00	19.89	9.25	69.62	22.72	26.51	.95
	Spot,	491.17	17.56	8.17	70.83	23.23	27.10	.97
Average cotton-seed feed ration.		548.73	19.59	9.10	76.10	26.18	30.54	1.09
Average hay ration,		574.99	20.53	9.55	79.90	27.02	31.53	1.13
Percentage increase hay over cotton-seed period.		4.6+	-	-	4.8+	3.1+	-	-

In this experiment, the results are the reverse of those obtained in the first test, the hay period yielding several per cent. more milk, milk solids and fat. Our observations of the animals from day to day during the trial indicated that the cotton-seed feed ration was falling slightly behind the hay ration. The animals, being in the early part of the lactation period, would naturally be more sensitive to the effect of food than in the latter portion of the period of lactation.

Dry and Digestible Matter required to produce Milk and Butter (Per Cent.).

DRY MATTER REQUIRED TO PRODUCE —	Cotton-seed Period.	Hay Period.	Digestible Matter required to produce —	Cotton-seed Period.	Hay Period.
100 pounds milk, . .	118.70	113.60	100 pounds milk, .	70.90	66.90
1 pound milk solids, .	8.56	8.18	1 pound milk solids, .	5.11	4.81
1 pound milk fat, . .	24.88	24.17	1 pound milk fat, .	14.86	14.22
1 pound butter, . .	21.38	20.70	1 pound butter, . .	12.77	12.18

Market Cost of Feed Stuffs.

Wheat bran, ...	$14 00	per ton.
Chicago gluten meal, ...	18 00	"
Mangolds, ...	3 00	"
Hay, ...	15 00	"
Cotton-seed feed, ...	15 00	"

Cost of Feed to produce Milk and Butter. Average for Six Cows (Cents).

	Daily Feed.	100 Pounds Milk.	Quart Milk.	Pound Butter Fat.	Pound Butter.
Cotton-seed period, ...	21.32	110.6	2.38	23.40	20.10
Hay period, ...	21.32	104.9	2.26	22.69	19.38
Increased percentage cost of cotton-seed over hay period.	-	5.2+	-	-	3.2+

The cotton-seed rations slightly increased the cost of the milk and butter.

D. Average Results from Two Experiments.

It is thought desirable to bring together the results of both experiments, believing that they will give a fair representation of the relative values of like quantities of cotton-seed feed and a good quality of hay.

1. Total Live Weight gained by the Six Cows in Both Experiments (Pounds).

Cotton-seed feed periods, ...	95
Hay periods, ...	166

2. Average Dry and Digestible Matter Consumed Daily (Pounds).

	Total Dry Matter.	Digestible.				Nutritive Ratio.
		Protein.	Fat.	Carbohydrates.	Total.	
Cotton-seed period, .	22.57	2.32	.82	10.39	13.40	1:5.35
Hay period, ...	22.65	2.41	.59	10.61	13.61	1:5.00

These figures show very slight variations.

3. Total Milk and Butter Yields (Pounds).

	Milk.	Milk Solids.	Milk Fat.	Butter.
Cotton-seed period, ...	5867	823.5	290.4	338.5
Hay period, ...	5933	826.3	281.1	328.0
Percentage increase hay over cotton-seed,	1.1+	.34+	3.2—	3.2—

These variations can be regarded as within the limits of experimental error.

4. Average Feed Cost of Milk and Butter (Cents).

	Daily Cost of Feed.	100 Pounds Milk.	Quart Milk.	Pound Butter Fat.	Pound Butter.
Cotton seed period, ...	20.19	102.6	2.20	20.79	17.79
Hay period, ...	20.14	102.5	2.19	21.80	18.63
Percentage increased cost of hay over cotton-seed.	±	±	±	4.63+	4.5+

The 4.6 percentage increased cost of butter in the hay period is due to the rather unexpected results in the first experiment.

5. Dry and Digestible Matter required to produce Milk and Butter.

I. Dry Matter (Pounds).

	100 Pounds Milk.	Pound Milk Solids.	Pound Butter Fat.	Pound Butter.
Cotton-seed period, ...	112.9	8.04	22.79	19.56
Hay period, ...	112.6	8.08	23.72	20.37

II. Digestible Matter (Pounds).

	100 Pounds Milk.	Pound Milk Solids.	Pound Butter Fat.	Pound Butter.
Cotton-seed period,	67.65	4.81	13.66	11.72
Hay period,	67.69	4.85	14.25	12.22

General Conclusions.

Cotton-seed feed, from its appearance, is certainly not an attractive looking article for consumption. The cotton-seed hulls, comprising the bulk of the feed, consists of the dark seed coats, together with an entangling mass of fibre. They are difficult to masticate, and quite indigestible. The cotton-seed meal with which the hulls are mixed imparts its flavor to the material, and actually increases the digestibility of the hulls. In our experiments we have had no trouble in inducing animals to eat 12 to 15 pounds daily within three or four days. The two experiments have shown cotton-seed feed to give as large milk and butter yields, at as low a cost, as a good quality of hay. The writer is of the opinion, however, that this feed requires more energy for its digestion than hay, and, when fed for any length of time, would have a tendency to induce digestive disturbances. A mixture of hulls and meal could probably be turned to better account for fattening steers than as a continuous feed for dairy cows. Massachusetts farmers could derive no benefit from feeding this material in place of hay. For those who are obliged to purchase all of their coarse feeds, it might be desirable to use one-half of this material in place of hay, provided it could be purchased for somewhat less money. Cotton-seed feed should be consumed where it is produced. For the farmers of the south it is undoubtedly a cheap source of coarse feed, and, when fed in moderate quantities, will unquestionably return good results.

Analytical Data.

Dry Matter Determinations (Per Cent.).

Experiment I.

	Hay.	Millet and Soy Bean Ensilage.	Cotton seed-Feed.	Wheat Bran.	Linseed Meal.	Peoria Gluten Feed.
April 8 through April 28, .	90.33	18.79	89.00	87.89	90.58	93.04
May 11 through May 31, .	89.84	20.58	88.10	87.86	90.48	93.23

Experiment II.

	Hay.	Mangolds.	Cotton-seed Feed.	Wheat Bran.	Chicago Gluten Meal.
Hay * and cotton-seed periods, . .	87.60	8.00	87.8	87.2	90.6

* The dry matter determinations varied so little in the two halves of this experiment that the average in each case was taken.

Composition of Feeds (Per Cent.).

Experiment I.

	Hay.	Millet and Soy Bean Ensilage.	Cotton-seed Feed.	Wheat Bran.	Linseed Meal.	Peoria Gluten Feed.
Ash, ...	5.94	12.77	3.82	6.42	4.94	1.07
Fibre, ...	32.00	34.02	39.67	11.37	7.26	7.13
Fat, ...	3.07	2.59	3.90	5.73	7.05	7.59
Protein, ...	11.07	9.40	13.02	18.68	41.99	23.83
Extract matter, . . .	47.92	41.22	39.59	57.80	38.76	60.38

Experiment II.

	Hay.	Mangolds.	Cotton-seed Feed.	Wheat Bran.	Chicago Gluten Meal.
Ash, ...	5.78	15.49	3.51	7.11	1.52
Fibre, ...	33.98	10.67	40.60	12.06	3.21
Fat, ...	2.68	.73	3.69	5.69	7.35
Protein, ...	8.41	14.35	11.96	18.12	40.38
Extract matter, ...	49.15	58.76	40.13	57.00	47.51

Coefficients of Digestibility.

Experiment I.

	Hay.	Ensilage.	Cotton-seed Feed.	Wheat Bran.	Linseed Meal.	Peoria Gluten Feed.	Chicago Gluten Meal.	Mangolds.
Fibre,	66	60	50	22	57	78	-	-
Fat,	58	72	89	71	89	79	-	-
Protein,	62	57	39	78	89	83	-	-
Extract Matter,	64	59	58	68	78	90	-	-

Experiment II.

	Hay.	Ensilage.	Cotton-seed Feed.	Wheat Bran.	Linseed Meal.	Peoria Gluten Feed.	Chicago Gluten Meal.	Mangolds.
Fibre,	58	-	55	22	-	-	-	43
Fat,	50	-	93	68	-	-	93	-
Protein,	54	-	42	79	-	-	89	75
Extract Matter,	56	-	59	69	-	-	93	91

Composition of Milk (Per Cent.).

Experiment I.

	Ada.		Red Spot.		Bessie	
	Solids.	Fat.	Solids.	Fat	Solids.	Fat.
Cotton-seed period,	13.84	4.93	14.01	4.84	13.63	4.93
	13.82	5.00	14.48	5.59	-	-
Average,	13.83	4.96	14.24	5.21	13.63	4.93
Hay period,	13.57	4.62	13.95	4.64	13.26	4.53
	-	-	-	-	13.47	4.52
Average,	13.57	4.62	13.95	4.64	13.36	4.52

Experiment I. — Concluded.

	Beauty.		Red.		Spot.	
	Solids.	Fat.	Solids.	Fat.	Solids.	Fat.
Cotton-seed period, . .	15.08	5.62	14.03	5.05	14.88	5.38
	-	-	-	-	15.28	5.43
Average, . . .	15.08	5.62	14.03	5.05	15.08	5.40
Hay period, . . .	14.54	5.13	13.91	4.72	14.77	5.27
	14.61	5.05	13.87	4.60	-	-
Average, . . .	14.57	5.09	13.89	4.66	14.77	5.27

Experiment II.

	Mary.		Jennie.		Nora.	
	Solids.	Fat.	Solids.	Fat.	Solids.	Fat.
Cotton-seed period, . .	13.96	4.64	14.36	4.73	13.39	4.43
	13.81	4.80	14.58	5.33	13.44	4.58
	14.20	4.93	14.58	4.92	13.52	4.63
	13.91	4.74	14.73	5.00	13.45	4.60
Average, . . .	13.97	4.74	14.56	5.00	13.45	4.55
Hay period, . . .	13.76	4.73	14.79	5.45	13.00	3.81
	13.86	4.75	15.39	5.88	12.93	4.10
	14.01	4.85	15.55	6.00	13.46	4.17
	13.85	4.68	15.37	5.78	13.28	4.07
Average, . . .	13.87	4.75	15.27	5.78	13.17	4.04

Experiment II.—Concluded.

	Beauty.		Red.		Spot.	
	Solids.	Fat.	Solids.	Fat.	Solids.	Fat.
Cotton-seed period,	14.62	5.35	12.48	3.89	14.57	5.08
	13.95	4.85	11.88	3.98	14.77	5.05
	14.66	5.48	12.60	4.02	14.92	5.15
	14.46	5.40	12.23	3.68	13.90	5.68
Average,	14.42	5.27	12.30	3.87	14.54	5.23
Hay period,	-	-	12.26	4.00	14.01	4.34
	14.12	4.93	12.41	4.05	14.14	4.75
	14.49	4.97	12.74	4.20	14.59	4.94
	14.19	4.80	12.53	4.08	14.94	4.91
Average,	14.27	4.90	12.49	4.08	14.42	4.73

Average Results of Six Cows.

	Experiment I.		Experiment II.	
	Solids.	Fat.	Solids.	Fat.
Cotton-seed period,	14.31	5.18	13.87	4.78
Hay period,	14.02	4.80	13.91	4.71

Each distinct analysis represents a composite sample from 8 different milkings. In Experiment I., samples were taken for four days of the last two weeks only. In Experiment II., each analysis represents the comparison of the milk for each of the four weeks.

REPORT OF THE ENTOMOLOGIST.

CHARLES H. FERNALD.

Two bulletins have been issued from this department during the year, — one on the habits, food and economic value of the American toad (*Bufo lentiginosus americanus*), and one on the brown-tail moth (*Euproctis chrysorrhœa*). I have been able in the intervals of other duties to prepare a monograph of the plume-moths (*Pterophoridæ*) of North America, which is published with illustrations in the thirty-fifth annual report of the college. A large amount of time has also been devoted to the work on the gypsy moth in the eastern part of the State.

San José Scale.

The San José scale (*Aspidiotus perniciosus*) has appeared in many places in Massachusetts, having been received on nursery stock from nurseries both in this and in other States. In the early part of the season my assistants visited, as far as possible, all the nurseries in the State, and carefully examined them for this scale. Most of them appeared to be entirely free from this insect, but a few were more or less infested. The owners of these infested nurseries have taken the most active measures to destroy this pest, under the supervision of one of my assistants. Many of the nurserymen do not raise a sufficient amount of stock to supply all of their orders, and often purchase from outside sources. This stock is often received and sent out without examination, and in this way it is possible for the San José scale to be distributed by those whose nurseries are not infested. A bulletin on the San José scale will be published as soon as other duties will permit, in which will be given a more complete account of the condition of the nurseries visited, together with the measures taken to eradicate the pest.

The scale insects have been and are still being introduced into this country from other parts of the world, and in this way we are liable at any time to find new or unknown species on our fruit or ornamental trees and shrubs and in our green-houses. It therefore seems wise to learn as much as possible about these insects, in order that we may know what to do with those already here, and any that may hereafter be brought into this country. To this end, more than six hundred circular letters were sent out to all entomologists whose names and addresses could be obtained, asking for specimens of two genera of the scale insects, and already a large amount of material has been received. Prof. R. S. Lull has undertaken to work up and prepare a monograph of the genus *Pulvinaria*, and Mr. R. A. Cooley a monograph of the genus *Chionaspis*. Very commendable progress has already been made by these two gentlemen.

Army Worm.

During the summer of 1896 the army worm (*Leucania unipuncta*) was very abundant in Amherst and in many other parts of the State, often in destructive numbers, and in the correspondence with this department information concerning this insect was asked for more than of all others combined. During the summer of 1897, however, the army worm seems to have been present in so few numbers as to have done no harm, and it was not referred to in a single letter received by me. It is a well-known fact that this insect has never in the past appeared in destructive numbers two years in succession in the same place, and the past season seems to have been no exception. The caterpillars were reported in many cases to have been more or less infested with the eggs of a parasitic fly. These eggs no doubt hatched and the young maggots made their way into the caterpillars and destroyed them, thus reducing the army worm to insignificant numbers, so that the few remaining have been entirely overlooked.

Plant Lice.

While the army worm has been very scarce during the past season, the aphids or plant lice have been very abundant on trees and shrubs, and many letters have been received, asking

how to destroy them. The best method, so far as known, is to spray the trees with kerosene emulsion; but in spraying it is very difficult to reach every insect, and, as they multiply very rapidly, they soon become as abundant as ever, and it becomes necessary to spray the trees or shrubs repeatedly after short intervals.

Tobacco Cutworm.

Early in the season cutworms were said to be destroying the young tobacco plants in the tobacco fields of the Connecticut valley, and specimens that were brought in and bred to maturity developed into moths which proved to be *Carneades messoria.* The caterpillars of this species partake of a rather varied diet, consisting not only of tobacco, but also of cabbage, corn, potatoes, spinach, onions, lettuce and fruit trees. The usual method taken by our tobacco growers, so far as I can learn, is to reset tobacco plants where they have been cut off by the worms, and at the same time dig out and destroy the worm that has done the mischief.

Canker Worms.

Four years ago canker worms began to increase so rapidly in this town that public attention was called to them, and a general account of the species occurring in Massachusetts was given with illustrations in Bulletin No. 20, published in January, 1893. In that bulletin the usual remedies were given. These consisted of tacking bands of heavy paper around the trunks of the trees and painting these bands with prepared printers' ink, repainting with the ink as often as it became dry or hardened enough to permit the females to cross the band. The method of protecting the trees with oil troughs of zinc or tin around the trunks was also mentioned. It was finally stated that probably the most effectual method was to spray the trees with Paris green in water as soon as the eggs hatched in the spring. A further account of canker worms was given in Bulletin No. 28, published in April, 1895.

A careful study of the different methods used to destroy these insects, which are so prevalent in many parts of this Commonwealth, has been made on thirteen apple trees on my own premises in Amherst. Three years ago these trees were

carefully banded with heavy paper and painted with Morrill's tree ink early in the spring, when the first females began to ascend the trees, and the painting was repeated as often as necessary. It was found that the ink would often harden on the trees even during the night following the application, and remain hard on the shady side long enough in the morning for some of the females to ascend the tree on that side, so that this method did not prove to be a perfect protection. The cost of the materials and of their application averaged about fifty cents to each tree.

The oil troughs are also quite expensive, and often leak so that the rain displaces the oil and then evaporates, allowing the females to ascend the trees; or spiders spin their webs across beneath the overhanging protection, forming a bridge on which the moths may easily pass, so that this device does not form a perfect protection.

Two years ago these trees were sprayed with Paris green in water, in the proportion of one pound to one hundred and fifty gallons, at a cost of five cents a tree, allowing fifteen cents an hour for labor. There was a strong wind blowing, and more time was required to do the work than would otherwise have been the case. Last year the same trees were sprayed with Paris green, in the same proportion as before. At this time it was nearly calm, and the cost of spraying was three cents a tree. The contrast between these trees and those on adjacent lots were very marked, for the sprayed trees retained their foliage and yielded a full crop, while the unsprayed trees were stripped of leaves, and bore no fruit. These trees were sprayed but once, and this method appears to have been more effectual and far cheaper than the others. In case of rain it might be necessary to repeat the spraying, but even then it would be the cheaper method.

REPORT OF THE CHEMIST.

DEPARTMENT OF FERTILIZERS AND FERTILIZER MATERIALS.

CHARLES A. GOESSMANN.

Assistants: HENRI D. HASKINS, CHARLES I. GOESSMANN, GEORGE D. LEAVENS.

I. Report on Official Inspection of Commercial Fertilizers.
II. Report on General Work in the Chemical Laboratory.
III. Observations with Special Fertilizers on Tobacco raised in Massachusetts.

I. REPORT ON OFFICIAL INSPECTION OF COMMERCIAL FERTILIZERS AND AGRICULTURAL CHEMICALS IN 1897.

CHARLES A. GOESSMANN.

Sixty-six manufacturers and dealers in commercial fertilizers and agricultural chemicals have secured, during the past year, licenses for the sale of their goods in the State. Thirty-six of these parties have offices for the general distribution of their goods in Massachusetts; the remainder reside in other States, — ten in New York, six in Connecticut, three in Rhode Island, three in Vermont, two in Pennsylvania, one in Maryland, one in Illinois, one in Ohio and three in Canada.

The number of distinct brands licensed, including agricultural chemicals, amounted to two hundred and ninety.

The collecting and sampling of the material for official analyses were in charge of Mr. R. H. Smith, a graduate of

the Massachusetts Agricultural College in the class of 1892, who since his graduation has been an efficient assistant in the chemical laboratory of the experiment station for the examination of commercial fertilizers.

Four hundred and fifteen samples of fertilizer have thus far been collected during the present year; of these, three hundred and one samples, representing two hundred and twenty-three distinct brands, were analyzed by the close of the month of November, and the results published in July and November bulletins, Nos. 48 and 49, of the Hatch Experiment Station of the Massachusetts Agricultural College. The remaining samples, in common with others coming under our observation before the expiration of the licenses, will be analyzed in due time, and the results published in conformity with our laws for the regulation of the trade in commercial fertilizers.

The results of the inspection during the past season are, on the whole, quite satisfactory, and if anything are an improvement on the results of the preceding year. The beneficial results of improved machinery and of improved skill in the management of the manufacture of fertilizers show themselves in a marked degree when compared with the general character of commercial fertilizers in earlier periods of the business.

To render the actual conditions of the trade in commercial fertilizers during the past season more prominent, a summary of our results is here inserted. In reading the subsequent statement, it has to be remembered that only the lowest stated guarantee is legally binding in all sales: —

(*a*) Where three essential elements of plant food were guaranteed: —

Number with three elements equal to or above the highest guarantee,	3
Number with two elements above the highest guarantee,	2
Number with one element above the highest guarantee,	60
Number with three elements between the lowest and highest guarantee,	69
Number with two elements between the lowest and highest guarantees,	63
Number with one element between the lowest and highest guarantees,	16

Number with two elements below the lowest guarantee, . . .	6
Number with one element below the lowest guarantee, . . .	29

(*b*) Where two essential elements of plant feed were guaranteed: —

Number with two elements above the highest guarantee, . .	3
Number with one element above the highest guarantee, . . .	10
Number with two elements between the lowest and highest guarantees, ...	13
Number with one element between the lowest and highest guarantees, ...	12
Number with one element below the lowest guarantee, . . .	6
Number with two elements below the lowest guarantee, . . .	3

(*c*) Where one essential element of plant food was guaranteed: —

Number above the highest guarantee, ...	10
Number between the lowest and highest guarantees, . . .	23
Number below the lowest guarantee,.	1

The modes of analyses adopted in this work were in all essential points those recommended by the Association of Official Chemists.

Attention has been called, in previous reports, to the fact that the introduction of a more liberal amount of potash into the make-up of a large class of so-called complete manures has become from year to year more general. This change has been slow but decided, and in a large degree may be ascribed to the daily increasing evidence, resulting from actual observations in field and garden, that the farm lands of Massachusetts are frequently especially deficient in potash compounds, and consequently need in many instances a more liberal supply of available potash from outside sources to give satisfactory returns. Whenever garden vegetables, fruits and forage crops constitute the principal products of the land, this recent change in the mode of manuring deserves a particularly careful trial; for the crops raised consume exceptionally large quantities of potash, as compared with grain crops. In view of these facts, it will be conceded that a system of manuring farm and garden which tends to meet the more satisfactory recognized conditions of large areas of land, as well as the special wants of important growing branches of agricultural industries, is a movement in the right direction.

In repeating these statements, it is not assumed that it will

remain economical to continue the practice after a repeated application of a liberal amount of potash, without some special reason.

To restore to the soil those essential manurial constituents which the crops carry off is a safe rule to follow in the effort to secure the maintenance of the fertility of the soil; yet to obtain this result in the most economical way will always remain the ultimate aim of farming as a business enterprise.

A judicious management of the trade in commercial fertilizers implies a due recognition of results well established by experiment, regarding the requirements of a remunerative production of farm and garden crops; yet, as the manufacturer at best can only prepare the composition of his special fertilizers on general lines, not knowing the particular condition and character of the soil which ultimately receives them, it becomes of the utmost importance on the part of the farmer to make himself acquainted with his special wants of manurial substances, and to thus qualify himself for a more judicious selection from the various fertilizers offered for purchase.

The present condition of the trade in commercial fertilizers offers exceptional advantages to provide efficient manures for the raising of farm and garden crops of every description congenial to soil and climate. The various essential articles of plant food, as potash, phosphoric acid and nitrogen compounds, are freely offered for sale in forms suitable to render, by their addition, the different kinds of manurial refuse matter of the farm in a higher degree fit to meet the special wants of the crops to be raised.

As the physical conditions and chemical resources of soils on available plant food frequently differ widely even on the same farm, no definite rule can be given for manuring farm lands, beyond the advice to return to the soil in available form those plant constituents which the crops raised during the preceding years have abstracted in exceptionally large proportion, and which will be especially called for by the crops to be raised.

An intelligent selection of fertilizers from among the various brands offered for sale requires, in the main, two kinds

of knowledge; namely, that the brand of fertilizer in question actually contains the guaranteed quantities and qualities of essential articles of plant food at a reasonable cost, and that it contains them in such form and proportions as will best meet under existing circumstances the special wants of soil and crop.

In some cases it may be only phosphoric acid or nitrogen or potash; in others, two of them; and in others again, all three. A remunerative use of commercial fertilizers can only be secured by attending carefully to these considerations.

To assist farmers in selecting their fertilizers with reference to the wants of the crops they wish to cultivate, the writer has for years published in his annual reports a compilation of the analyses of farm and garden crops, to serve as a guide to all interested in a rational mode of manuring plants. Copies of these compilations of analyses may be secured by asking for them at the office of the Hatch Experiment Station at Amherst, Mass.

An economical use of manurial substances from any source is only possible after the local condition of the soil under consideration, as well as the special wants of the crops to be raised, have been duly considered. It becomes the business of every progressive farmer to acquire such information as is called for to select intelligently, from the various manurial resources at his disposal, those materials which will meet best his wants for a complete fertilizer.

In making choice from among the so-called complete fertilizers, two points seem to be in particular worth remembering. First, select them with reference to the amount, the quality and the kind of essential constituents they are guaranteed to contain, and not merely with reference to cost per ton; mere trade names are no guarantee of fitness. High-priced articles, when offered by reputable manufacturers, have proved in many instances cheaper than low-priced goods. Second, buy your supplies of reputable dealers, and insist in all cases on a statement of guaranteed composition.

The majority of manufacturers and dealers in commercial fertilizers in Massachusetts have been for years on record, regarding the character of their goods, in the published re-

ports of the State inspector, which are open to the public; to these records this office invariably refers all parties asking for information in that direction.

Valuation of Commercial Fertilizers.

The market value of the higher grades of agricultural chemicals and compound fertilizers depends in the majority of cases on the amount and the particular form of three essential articles of plant food which they contain, *i.e.*, nitrogen, potash and phosphoric acid. Supply and demand control the temporary market prices not less in the fertilizer trade than in other lines of commercial business.

The approximate market value of a fertilizer, simple or compound, is obtained by multiplying the pounds contained in a ton of two thousand pounds by the trade value per pound of each of the three above-stated essential constituents of plant food present. The same course is adopted with reference to the different forms of each, wherever different prices are recognized in the trade. Adding the different values per ton obtained, we find the total value per ton at the principal place of distribution.

As farmers are quite frequently not in the position to secure the desired information regarding the market cost of fertilizers they wish to secure, the official inspectors of commercial fertilizers have aided them for years in ascertaining the current market prices of the following leading or standard raw materials: —

Sulphate of ammonia.	Ammoniate.
Nitrate of soda.	Castor pomace.
Muriate of potash.	Linseed meal.
Sulphate of potash.	Dried blood.
Cotton-seed meal.	Dried ground meat.
Dry ground fish.	Bone and tankage.
Azotin.	Plain superphosphates, etc.

Which serve largely in the manufacture of good fertilizers for our market; and have published the results of their inquiries in form of tables, stating the average trade values per pound, for the six months preceding, of the different kinds and forms of fertilizing materials at the leading places of distribution.

The market value of fertilizing ingredients, like other merchandise, is liable to changes during the season. The values stated below are based on the condition of the fertilizer market in centres of distribution in New England during the six months preceding March, 1897: —

Trade Values of Fertilizing Ingredients in Raw Materials and Chemicals, 1897 (Cents per Pound).

Nitrogen in ammonia salts,	13.5
Nitrogen in nitrates,	14.0
Organic nitrogen in dry and fine-ground fish, meat, blood and in high-grade mixed fertilizers,	14.0
Organic nitrogen in cotton-seed meal, linseed meal and in castor pomace,	12.0
Organic nitrogen in fine-ground bone and tankage,	13.5
Organic nitrogen in medium-ground bone and tankage,	11.0
Organic nitrogen in coarse bone and tankage,	8.0
Phosphoric acid soluble in water,	5.5
Phosphoric acid soluble in ammonium citrate,	5.0
Phosphoric acid in fine bone and tankage,	5.0
Phosphoric acid in medium bone and tankage,	4.0
Phosphoric acid in coarse bone and tankage,	2.5
Phosphoric acid in fine-ground fish, cotton-seed meal, linseed meal, castor pomace and wood ashes,	5.0
Phosphoric acid insoluble (in am. cit.) in mixed fertilizers,	2.0
Potash as sulphate, free from chlorides,	5.0
Potash as muriate,	4.5

From these figures it is apparent that the best forms of nitrogen and phosphoric acid have suffered a material reduction in cost, as compared with preceding years.

The market value of low-priced materials used for manurial purposes, as salt, wood ashes, various kinds of lime, barn-yard manure, factory refuse and waste materials of various description, quite frequently does not stand in a close relation to the current market value of the amount of essential articles of plant food they contain. Their cost varies in different localities. Local facilities for cheap transportation, and more or less advantageous mechanical conditions for speedy action, exert, as a rule, a decided influence on their selling price.

The mechanical condition of any fertilizing material, simple or compound, deserves the most serious consideration of farmers when articles of a similar chemical character are

offered for their choice. The degree of pulverization controls, almost without exception, under similar conditions, the rate of solubility, and the more or less rapid diffusion of the different articles of plant food throughout the soil.

The state of moisture exerts a no less important influence on the pecuniary value in case of one and the same kind of substance. Two samples of fish fertilizers, although equally pure, may differ from fifty to one hundred per cent. in commercial value, on account of mere difference in moisture.

Crude stock for the manufacture of fertilizers, and refuse materials of various descriptions, have to be valued with reference to the market price of their principal constituents, taking into consideration at the same time their general fitness for speedy action.

Consumers of commercial manurial substances will do well to buy, whenever practicable, on a guarantee of composition of their essential constituents, and to see to it that the bill of sale recognizes the point of the bargain. Any mistake or misunderstanding in the transaction may be readily adjusted, in that case, between the contending parties. The responsibility of the dealer ends with furnishing an article corresponding in its composition with the lowest stated quantity of each specified essential constituent.

It is of the first importance, when buying fertilizers for home consumption, to consider their cost with reference to what they promise to furnish.

List of Manufacturers and Dealers who have secured Certificates for the sale of Commercial Fertilizers in the State during the Past Year (May 1, 1897, to May 1, 1898) and the Brands licensed by Each.

The Armour Fertilizer Works, Chicago, Ill.: —
- Bone Meal.
- Bone and Blood.
- Ammoniated Bone and Potash.
- All Soluble.
- Bone, Blood and Potash.
- Grain Grower.

American Fertilizer Co., Boston, Mass.: —
- Alkali Nitrate Phosphate for Hoed Crops.

American Fertilizer Co. — *Con.*
- Alkali Nitrate Phosphate for Grass and Grain.
- General American Fertilizer.
- Potato Fertilizer.

Wm. H. Abbott, Holyoke, Mass.: —
- Eagle Brand for Grass and Grain.
- Complete Tobacco Fertilizer.
- Animal Fertilizer.

American Cotton Oil Co., New York, N.Y.: —
- Cotton-seed Meal.

Bartlett & Holmes, Springfield, Mass.:—
Pure Ground Bone.
Animal Fertilizer.
Tankage.

H. J. Baker & Bro., New York, N. Y.:—
Pure Ground Bone.
Standard Un X Ld Fertilizer.
Strawberry Manure.
Potato Manure.
Tobacco Manure.
Grass and Grain Manure.
A. A. Ammoniated Superphosphate.
Harvest Home Fertilizer.

C. A. Bartlett, Worcester, Mass.:—
Fine-ground Bone.
Animal Fertilizer.

Berkshire Mills Co., Bridgeport, Conn :—
Complete Fertilizers.
Ammoniated Bone Phosphate.

Bowker Fertilizer Co., Boston, Mass.:—
Stockbridge Special Manures.
Hill and Drill Phosphate.
Farm and Garden Phosphate.
Lawn and Garden Dressing.
Fish and Potash.
Potato and Vegetable Manure.
Potato Phosphate.
Market Garden Manure.
Sure Crop Phosphate.
Gloucester Fish and Potash.
High-grade Fertilizer.
Essex Fertilizer.
Bone and Wood Ash Fertilizer.
Nitrate of Soda.
Dried Blood.
Dissolved Bone-black.
Muriate of Potash.
Sulphate of Potash.

William E. Brightman, Tiverton, R.I.:—
Potato and Root Manure.
Phosphate.
Fish and Potash.

Bradley Fertilizer Co., Boston, Mass.:—
X. L. Superphosphate.
Potato Manure.
B. D. Sea Fowl Guano.
Complete Manures.
Fish and Potash.
High-grade Tobacco Manure.
English Lawn Fertilizer.
Ammoniated Bone Phosphate.
Breck's Lawn and Garden Dressing.
Sulphate of Potash.

Bradley Fertilizer Co. — *Con.*
Muriate of Potash.
Nitrate of Soda.
Sulphate of Ammonia.
Dissolved Bone-black.
Fine-ground Bone.

Daniel T. Church, Providence, R.I. (E. Wilcox, general agent):—
Church's B Special.
Church's C Standard.
Church's D Fish and Potash.

The Cleveland Linseed Oil Co., Cleveland, O.:—
Screened Linseed Meal.

Clark's Cove Fertilizer Co., Boston, Mass.:—
Bay State Fertilizer.
Bay State Fertilizer G. G. Brand.
Great Planet Manure.
Potato and Tobacco Fertilizer.
King Philip Guano.
Potato Manure.
Fish and Potash.
White Oak Pure Bone Meal.

Cleveland Dryer Co., Boston, Mass.:—
Superphosphate.
Potato Phosphate.
Cleveland Fertilizer.

E. Frank Coe Co., New York, N.Y.:—
High-grade Potato Fertilizer.
Bay State Ammoniated Bone Superphosphate.
Bay State Potato Manure.
High-grade Ammoniated Bone Superphosphate.
Gold Brand Excelsior Guano.
Fish Guano and Potash.

Crocker Fertilizer and Chemical Co., Buffalo, N. Y.:—
Ammoniated Bone Superphosphate.
Potato, Hop and Tobacco Phosphate.
Ammoniated Wheat and Corn Phosphate.
New Rival Ammoniated Superphosphate.
Practical Ammoniated Superphosphate.
Vegetable Bone Superphosphate.
General Crop Phosphate.
Universal Grain Grower.
Special Potato Manure.
New England Tobacco and Potato Grower.

Crocker Fertilizer and Chemical Co. — *Con.*
  Coolidge Bros. Special Truck Fertilizer.
  A. A. Complete Manure.
  Ground Bone Meal.
  Pure Ground Bone.
  Muriate of Potash.
  Nitrate of Soda.

Cumberland Bone Phosphate Co., Boston, Mass.: —
  Superphosphate.
  Potato Fertilizer.
  Concentrated Phosphate.
  Guano.

City Florist, Brockton, Mass.: —
  Boo Boo Plant Food.

L. B. Darling Fertilizer Co., Pawtucket, R. I.: —
  Animal Fertilizer.
  Potato and Root Crop Manure.
  Lawn Dressing.
  Tobacco Grower.
  Blood, Bone and Potash.
  Special Formula.
  Fine-ground Bone.
  Muriate of Potash.
  Nitrate of Soda.

John C. Dow & Co., Boston, Mass.: —
  Ground Bone Fertilizer.
  Nitrogenous Superphosphate.
  Pure Ground Bone.

W. E. Fife & Co., Clinton, Mass.: —
  Wood Ashes.

Great Eastern Fertilizer Co., Rutland, Vt.: —
  Northern Corn Special.
  General Fertilizer.
  Vegetable Vine and Tobacco Fertilizer.
  Garden Special.
  Soluble Bone and Potash.

Thomas Hersom & Co., New Bedford, Mass.: —
  Bone Meal.
  Meat and Bone.

Alonzo P. Henderson, Hanover, Mass.: —
  Acme Brand Fertilizer.

Edmund Hersey, Hingham, Mass.: —
  Ground Bone.

John G. Jefferds, Worcester, Mass.: —
  Animal Fertilizer.
  Potato Manure.
  Fine-ground Bone.

Thomas Joint, St. Helen, Ontario, Can.: —
  Unleached Hard-wood Ashes.

Thomas Kirley, South Hadley Falls, Mass.: —
  Pride of the Valley.

A. Lee & Co., Lawrence, Mass.: —
  Lawrence Fertilizer.

Lowell Fertilizer Co., Boston, Mass.: —
  Bone Fertilizer for Corn and Grain.
  Complete Manure for Vegetables.
  Animal Fertilizer.
  Potato Phosphate.
  Bone and Potash.
  Lawn Dressing.
  Tobacco Manure.
  Empire Fertilizer.

Lowe Bros. & Co., Fitchburg, Mass.: —
  Tankage.

F. L. Lalor, Dunville, Ontario, Can.: —
  Canada Unleached Hard-wood Ashes.

The Mapes Formula and Peruvian Guano Co., New York, N. Y.: —
  Bone Manures.
  Superphosphates.
  Special Crop Manures.
  Sulphate of Potash.
  Double Manure Salts.
  Nitrate of Soda.

E. McGarvey & Co., London, Ontario, Can.: —
  Unleached Hard-wood Ashes.

McQuade Bros., West Auburn Mass.: —
  Fine-ground Bone.

Geo. L. Monroe, Oswego, N. Y.: —
  Canada Unleached Hard-wood Ashes.

National Fertilizer Co., Bridgeport, Conn.: —
  Complete Fertilizers.
  Ammoniated Bone.

National Fertilizer Co. — *Con.*
- Market-garden Manure.
- Potato Phosphate.
- Fish and Potash.
- Ground Bone.

Niagara Fertilizer Works, Buffalo, N. Y.: —
- Wheat and Corn Producer.
- Grain and Grass Grower.
- Potato, Tobacco and Hop Fertilizer.
- Niagara Triumph.

New England Dressed Meat and Wool Co., Boston, Mass.: —
- Sheep Fertilizer.

Packers Union Fertilizer Co., New York, N. Y.: —
- Universal Fertilizer.
- Wheat, Oats and Clover Fertilizer.
- Animal Corn Fertilizer.
- Potato Manure.
- Gardener's Complete Manure.

Pacific Guano Co., Boston, Mass : —
- Soluble Pacific Guano.
- Special Potato Manure.
- Special for Potatoes and Tobacco.
- Nobsque Guano.
- High-grade General Fertilizer.

Parmenter & Polsey Fertilizer Co., Peabody, Mass.: —
- Plymouth Rock Brand.
- Star Brand Fertilizer.
- Butman Brand Fertilizer.
- Special Potato.
- Strawberry.
- Ground Bone.
- Muriate of Potash.
- Sulphate of Potash.
- Nitrate of Soda.

A. W. Perkins & Co., Rutland, Vt.: —
- Plantene.

Prentiss, Brooks & Co., Holyoke, Mass.: —
- Complete Manures.
- Phosphate.
- Nitrate of Soda.
- Muriate of Potash.
- Sulphate of Potash.

Preston Fertilizer Co., Brooklyn, N. Y.: —
- Ammoniated Bone Superphosphate.

Quinnipiac Co., Boston, Mass.: —
- Phosphate.
- Potato Manure.
- Market-garden Manure.
- Fish and Potash.
- Havana Tobacco Grower.
- Grass Fertilizer.
- Corn Manure.
- Potato Phosphate.
- Onion Manure.
- Pure Ground Bone.
- Dry Ground Fish.
- Muriate of Potash.
- Sulphate of Potash.
- Nitrate of Soda.
- Sulphate of Ammonia.
- Dissolved Bone-black.

Read Fertilizer Co., New York, N. Y. (H. D. Foster, general agent): —
- Standard Fertilizer.
- High-grade Farmers' Friend.
- Practical Potato Special.
- Farmer's Friend,
- Vegetable and Vine.

N. Roy & Son, South Attleborough, Mass.: —
- Complete Animal Fertilizer.

The Rogers & Hubbard Co., Middletown, Conn.: —
- Soluble Potato Manure.
- Soluble Tobacco Manure.
- Fairchild's Formula for Corn and General Crops.
- Fruit Fertilizer.
- Grass and Grain Fertilizer.
- Oats and Top-dressing Fertilizer.
- Pure Raw Knuckle Bone Flour.
- Strictly Pure Fine Bone.
- Fertilizer for all Soils and all Crops.

Russia Cement Co., Gloucester, Mass.: —
- X X X Fish and Potash.
- High-grade Superphosphate.
- Corn, Grain and Grass Manure.
- Potato, Root and Vegetable Manure.
- Special Tobacco Fertilizer.
- Odorless Lawn Dressing.

Lucien Sanderson, New Haven, Conn.: —
- Formula A.
- Blood, Bone and Meat.
- Dissolved Bone-black.
- Nitrate of Soda.
- Sulphate of Potash.
- Muriate of Potash.

Edward H. Smith, Northborough, Mass.: —
Ground Bone.

J. Stroup & Son Co., Boston, Mass.: —
Hard-wood Ashes.

Thomas L. Stetson, Randolph, Mass.:—
Ground Bone.

Standard Fertilizer Co., Boston, Mass.:—
Standard Fertilizer.
Potato and Tobacco Fertilizer.
Standard Guano.
Complete Manure.
Fine-ground Bone.

C. F. Sturtevant, Hartford, Conn: —
Tobacco and Sulphur Fertilizer.

Henry F. Tucker, Boston, Mass.: —
Original Bay State Bone Superphosphate.
Imperial Bone Superphosphate.
Special Potato Fertilizer.

I. P. Thomas & Son Co., Philadelphia, Pa.: —
Martin's Bone Mixture.
So. Carolina Phosphate with Potash.
So. Carolina Phosphate.
Pure Ground Animal Bone.
Steamed Bone.
Improved Superphosphate.
Potato and Tomato Manure.
Normal Bone Phosphate.
Farmer's Choice Bone Phosphate.
Tobacco Fertilizer.

Walker, Stratman & Co., Pittsburg, Pa.: —
Potato Special.
Big Bonanza.
Smoky City.
Four Fold.

Andrew H. Ward, Boston, Mass.: —
Ward's Chemical Fertilizer.

I. S. Whittemore, Wayland, Mass.: —
Complete Manure.

D. Whithed, Lowell, Mass.: —
Champion Fertilizer.
Bone Meal.

The Wilcox Fertilizer Works, Mystic Conn.: —
Potato, Onion and Tobacco Manure.
Ammoniated Bone Phosphate.
High-grade Fish and Potash.
Dry Ground Fish Guano.

Williams & Clark Fertilizer Co., Boston, Mass.: —
Ammoniated Bone Superphosphate.
Potato Phosphate
High-grade Special.
Fine Wrapper Tobacco Grower.
Royal Bone Phosphate.
Corn Phosphate.
Potato and Tobacco Manure.
Grass Manure.
Fish and Potash.
Universal Ammoniated Dissolved Bone.
Prolific Crop Producer.
Onion Manure.
Bone Meal.
Dry Ground Fish.
Sulphate of Potash.
Muriate of Potash.
Nitrate of Soda.
Dissolved Bone-black.
Sulphate of Ammonia.

M. E. Wheeler & Co, Rutland, Vt.: —
High-grade Corn Fertilizer.
High-grade Potato Manure.
Superior Truck Fertilizer.
Havana Tobacco Grower.
High-grade Fruit Fertilizer.
High-grade Grass and Oats Fertilizer.
Electrical Dissolved Bone.

II. REPORT ON GENERAL WORK IN THE CHEMICAL LABORATORY.

CHARLES A. GOESSMANN.

1. Analyses of Materials sent on for Examination.
2. Notes on Barn-yard Manure.
3. Notes on Wood Ashes.
4. Notes on Cotton-seed Meal.
5. Notes on Guano from West Coast of Africa.
6. Notes on Ashes from Crematory Furnace for City Garbage.
7. Notes on Wool Washings.

1. Analyses of Materials sent on for Examination.

The work carried on in this connection is growing from year to year in importance. A large proportion of commercial manurial substances consists of by or waste products of various industries. The composition and general character of these materials depend on the current mode of manufacture. The rapid advancement in many branches of industries is at any time liable to affect more or less seriously the commercial as well as the manurial value of their waste products. A frequent examination of that class of materials cannot fail to benefit the vital interests of our farming community. For this reason arrangements were made, as in previous years, to attend to the examination of substances of interest to farmers to the full extent of the resources placed at the disposal of the officer in charge of this work. These investigations are carried on free of charge to farmers of the State. The results are considered public property, and are published from time to time in the bulletins of the station.

The number of substances tested in this connection amount to two hundred and thirty-eight. As the detailed results of

their analyses have already been published in three bulletins, Nos. 45, 48 and 49, March, July and November, 1897, a brief statement of the names of the different articles analyzed will, on this occasion, suffice to convey some idea of the extent and the character of the work accomplished. Only a few of these materials of more special importance are reserved for a subsequent short discussion.

The substances tested from Dec. 1, 1897, to Dec. 1, 1898, are as follows: wood ashes, 89; cotton-seed meal, 23; cotton-seed hull ashes, 3; cotton factory waste, 5; tankage, bone and fish, 17; muck, peat and soils, 16; chemicals, 14; acid phosphates and dissolved bone-blacks, 5; natural phosphates, 6; tobacco refuse, 2; complete fertilizers, 31; miscellaneous, 9; Damara land guano, garbage cremation ashes and wool washings, each 1.

Aside from this work are the complete analyses of 36 samples of tobacco leaves, together with numerous tests for the quality of ash and rate of combustion. See Bulletin No. 47, on tobacco experiments, published in April, 1897.

The responsibility of the genuineness of all articles sent on for examination rests with the parties asking for the analysis. Our publications of the results refer merely to the locality they come from, to avoid misunderstandings. Samples of fertilizers collected from original packages by authorized agents of the station in the general markets furnish the material for official analyses, and are considered genuine articles.

2. Notes on Barn-yard Manure.

The importance of barn-yard manure as a home source of plant food cannot be over-estimated in a mixed farm management. In a well-regulated rational system of stock feeding it is one of the cheapest if not the cheapest source of valuable manurial constituents. An exceptional liability to vary in composition is the strongest objection which can be raised against its exclusive use as a manure supply for the farm and garden, yet this objection has lost much of its force since the causes of variation are better understood, and may thus be avoided to a considerable extent. We have learned

how to improve its efficiency as a complete manure under varying conditions of soil as well as of varying wants of crops, by adding those manurial constituents which are called for in different relative proportions, and which the barn-yard manure on hand does not contain.

Analyses of Eighty Samples of Barn-yard Manure made at Amherst, Mass.

ANALYSIS.	POUNDS PER HUNDRED.			Pounds per Ton (2,000 Pounds).
	Highest.	Lowest.	Average.	
Moisture,	75.00	60.00	67.24	1344.80
Nitrogen,	1.36	.21	.52	10.40
Potassium oxide,	1.40	.13	.56	11.20
Phosphoric acid,	.75	.10	.39	7.80

The average barn-yard manure contains, as will be noticed from the above statement, a larger percentage of nitrogen as compared with potash and phosphoric acid than is generally considered economical in a complete fertilizer for general farm purposes.

The practice of adding to the manurial refuse materials of the farm, as stable manure, vegetable compost, etc., such single commercial manurial substances as will enrich them in the direction desirable for any particular crop, does not yet receive that degree of general attention which it deserves. An addition of potash in the form of muriate or sulphate of potash, or of phosphoric acid in the form of fine-ground South Carolina or Florida soft phosphate, etc., will in many instances not only improve their general fitness as complete manure, but quite frequently permit a material reduction in the amount of barn-yard manure ordinarily considered necessary to secure satisfactory results. An addition of from thirty to forty pounds of muriate of potash and one hundred pounds of fine-ground soft Florida phosphate per ton of barn-yard manure, at any time before applying the latter to the soil deserves recommendation.

3. Notes on Wood Ashes.

Forty per cent. of all articles sent on for examination consist of wood ashes. They are sold in the majority of cases under the trade name "Unleached Canada hard-wood ashes." Ninety-eight samples tested at the station during the past year gave the following results: —

	No. of Samples.
Moisture from 1 to 3 per cent.,	10
" 4 to 6 "	8
" 6 to 10 "	13
" 10 to 15 "	19
" 15 to 20 "	11
" 20 to 30 "	10
Moisture above 35 per cent.,	1
Potassium oxide above 8 per cent.,	3
" " from 7 to 8 per cent.,	8
" " " 6 to 7 "	21
" " " 5 to 6 "	28
" " " 4 to 5 "	10
" " " 3 to 4 "	3
" " below 3 per cent.,	none
Phosphoric acid above 2 "	4
" " from 1 to 2 per cent.,	45
" " below 1 per cent.,	24
Average per cent. of calcium oxide (lime),	34.29
Per cent. mineral matter insoluble in diluted hydrochloric acid, from — 6 to 10,	10
10 to 15,	30
15 to 20,	15
20 to 30,	3
above 30,	1

The variations noticeable in the composition of wood ashes are not surprising when we consider the crude mode of collecting and handling them for commercial purposes. The particular effects of both varying quantities of foreign insoluble matter, as soil, coal ashes, etc., and of moisture, on the composition of a given sample of genuine wood ashes, as far as its percentage of potash and of phosphoric acid is concerned, depend largely on the particular kind of wood which has served for the production of the ash. The color of the wood ashes in case of dark varieties depends usually on admixture of more or less charcoal, while an exceptionally light color is not unfrequently due to the kind of wood which furnishes it. Some kinds of wood, as elm

wood, produce a white ash of excellent quality, judging from samples sent on for examination.

As the dealer is only obliged to guarantee the amount of potash and of phosphoric acid present in a given quantity of wood ashes, no serious objection can be raised on the part of the buyer on account of moisture, etc., as long as the article contains the specified amount of both potash and phosphoric acid.

Wood ashes ought to be bought and sold by weight, and not by measure, for both moisture and foreign matters are apt to affect seriously the weight of a given measure.

Some dealers in wood ashes have adopted of late the practice of stating merely the sum of both, instead of specifying the amount of each of them present. As phosphoric acid and potassium oxide contained in wood ashes are considered in our section of the country, pound for pound of an equal commercial value, from 4.5 to 5 cents, no particular objection can be raised against a joint statement of both as far as the mere money value of the samples is concerned; yet, as this mode of stating the guaranteed composition is apt to lead to misconception and abuse, it ought to be discouraged and discontinued.

The large percentage of lime, from 30 to 40 per cent., found in genuine wood ashes, imparts a special agricultural value to them as a fertilizer, aside from the amount of potash and phosphoric acid they contain. Wherever an application of lime is desired, wood ashes deserve favorable consideration, on account of the superior mechanical condition of the lime they furnish.

4. Notes on Cotton-seed Meal as a Fertilizer.

Recent low prices of some concentrated feed stuffs have favored experiments to test their fitness for supplying directly nitrogen, phosphoric acid and potash for plant food. Whenever the market value of the amount of nitrogen, phosphoric acid and potash they contain compares fairly well with the market cost of these three ingredients, the trials deserve, for various reasons, encouragement.

The richness of cotten-seed meal, linseed meal, etc., as well as their marked disposition to rot in the presence of

moisture and of a fair average temperature, caused their selection. Both are quite frequently looked upon with favor as suitable materials to furnish plant food for various farm crops. Cotton-seed meal in particular is to-day used extensively by tobacco growers in the Connecticut River valley as the main source of nitrogen for that crop.

The increasing importance of cotton-seed meal as a fertilizer has been followed by the writer with a frequent examination of the articles sold in our markets to protect the interests of our farmers. Importers of cotton-seed meal, claiming that they sold their articles as a feed stuff and not as a fertilizer, declined as a rule until quite recently to take out a fertilizer license which would oblige them to sell with a stated guarantee of at least the nitrogen.

The results of sixty-five analyses carried on under my direction are as follows: —

	Per Cent.		
	Maximum.	Minimum.	Average.
Moisture,	10.80	3.90	7.00
Nitrogen,	7.95	2.08	6.60
Phosphoric acid,	3.36	.73	1.79
Potassium oxide,	2.38	.48	1.76

Allowing 12 cents for every pound of nitrogen, 5 cents per pound for each of phosphoric acid and potassium oxide, these three ingredients represent per ton a market value of —

$19.39 in case of our average sample of cotton-seed meal.
24:82 in case of our highest sample of cotton-seed meal.
6.20 in case of our lowest sample of cotton-seed meal.

The above-stated difference in the composition of cotton-seed meal is mainly due to the presence of more or less ground skins and husks of the cotton seed. Cotton-seed meal designed for fodder ought to be free from skins and husks, to deserve a recommendation for that purpose; cotton-seed meal to be used for fertilizer may contain more or

less of this substance, provided the entire material is finely ground and the price in accordance with the composition.

We advise farmers to buy cotton-seed meal, like all other fertilizing materials, on the basis of a guarantee of (at least) nitrogen as the basis of the bargain. For their information it seems but proper to state in this connection that the American Cotton Oil Company of New York has quite recently secured a license for the sale of their cotton-seed meal as a fertilizer in our State, and intend to sell on the basis of the amount of nitrogen their article contains.

5. Notes on Damara Land Guano.

The material which served for our examination was sent on to this office by Messrs. H. J. Baker & Bro. of New York City. It consisted of a bag containing two hundred pounds of guano, and was accompanied by analyses of two chemists of London, Eng. As every new source of a genuine guano claiming to resemble the Peruvian guano of earlier periods in the trade of commercial fertilizers must be of special importance to all interested in the temporary resources of our supplies of plant food, our results are briefly stated below:—

Analysis of Damara Land Guano (Per Cent.).

Moisture at 100° C.,	17.70
Organic matter,	25.63
Total ash,	56.67
Total nitrogen,	5.79
Nitrogen in form of ammoniates,	1.80
Nitrogen in form of nitrates,	.05
Nitrogen in form of organic matter,	3.94
Carbonic acid,	trace
Total phosphoric acid,	14.78
Soluble phosphoric acid,	4.90
Reverted phosphoric acid,	5.79
Insoluble phosphoric acid,	4.09
Total potassium oxide,	3.53
Potassium oxide soluble in water,	3.46
Sodium oxide,	7.03
Calcium oxide,	14.21
Magnesium oxide,	2.05
Iron and aluminum oxides,	trace
Sulphuric acid,	5.94
Chlorine,	5.77
Insoluble matter,	9.26

The results of our analyses of the sample (two hundred pound bag) kindly sent on for trial by Messrs. H. J. Baker & Bro., New York City, are fairly within the stated composition of English chemists. The guano, it is stated, has been brought from some islands off the west coast of Africa; it is a valuable material, as may be seen from our detailed statement.

6. Notes on Crematory Ashes from City Garbage.

In my annual report for 1895 (pages 160 and 161), special attention was called to two important recent modes of saving city garbage, kitchen refuse in particular, for manurial purposes. Sanitary considerations are the first cause of the introduction of these new modes of disposing of objectionable refuse matter, which promise to become from day to day more important as supplies of valuable fertilizer materials.

Our attention has been in particular called to the products of the crematory furnace ashes from Lowell, Mass. The article is evidently improving, in consequence of the adoption of a proper system of sifting and grinding the ashes, as will be seen from the accompanying analysis, representing, according to statement, one hundred tons. The selling price, from $10 to $11 per ton, invites serious trials, as a fertilizer furnishing potash, phosphoric acid and lime.

Analysis of Ashes from the Cremation of City Garbage (Per Cent.).

Moisture at 100° C.,	.53
Potassium oxide,	6.01
Sodium oxide,	15.65
Total phosphoric acid,	10.21
Available phosphoric acid,	2.34
Insoluble phosphoric acid,	7.87
Sulphuric acid (So_3),	4.57
Chlorine,	4.75
Carbonic acid (CO_2),	10.85
Calcium oxide,	20.22
Magnesium oxide,	1.16
Iron and alumina,	9.32
Insoluble matter,	24.26
Nitrogen (inactive lyan compounds),	.17

7. Notes on Wool Washings as a Source of Fertilizer.

It is a well-known fact that the skins of sheep and raw wool are coated with potash compounds of a soap-like nature. In many localities in Europe it is a common practice to turn to account for manuring grass lands the water used in washing sheep before shearing, as well as the wash water obtained from raw wool in factories. This is used in form of an overflow. Wherever meadows adjoin the place of washing wool, arrangements may be readily provided for turning the wool washings directly to account. Samples of raw wool tested here for potash some years ago gave the following results: —

Potassium oxide soluble in water (per cent.),	3.92
Potassium oxide soluble in diluted hydrochloric acid (per cent.),	4.20

Of interest in this connection are the results of examination of a material sent on from a factory in this State. The article was labelled "concentrated potash liquor," and described as obtained from the washings of wool with water after the grease had been extracted by naphtha. It consisted of a highly colored, thick, syrup-like mass, containing a liberal admixture of fine fibrous vegetable matter. An analysis made with reference to its approximate value as a fertilizer gave the following results: —

	Per Cent.
Moisture at 100° C.,	41.13
Dry matter,	58.87

The dry matter left behind contained: —

	Per Cent.
Potassium oxide,	10.15
Phosphoric acid,	.10
Nitrogen,	1.09

The commercial value of these ingredients per ton of the original substance at the present rates amounts approximately to $12.40. In charring the original material directly, 100 parts left behind 36.49 parts; the charred mass tested for potassium oxide showed 34.91 per cent. present, or 698.2 pounds of potassium oxide per ton of charred residue, which

equals 1,012 pounds of carbonate of potash per ton of charred residue practically free from chlorine.

The scarcity of a good quality of carbonate of potash for manurial purposes in case of tobacco and similar industrial crops ought to encourage attempts to turn the concentrated potash liquor to account.

The charred mass might serve directly as material for the manufacture of a high-grade potash fertilizer.

III. NOTES OF FIELD EXPERIMENTS WITH TOBACCO IN MASSACHUSETTS, 1893–96.

CHARLES A. GOESSMANN.

The experiments briefly described in the following pages were carried on with the co-operation of the Valley Tobacco Experiment Association of Massachusetts.

The officers of this organization consisted of President L. A. Crafts of Whately, Vice-President C. L. Fowler of Westfield, Secretary and Treasurer G. D. Fisk of Agawam; Board of Directors, W. A. Porter of Agawam and C. L. Warner of Hatfield.

Hatfield, Westfield and Agawam were chosen for the location of the experiments. The selection of the particular field in each place was left to a special committee of the association. In all cases a deep, sandy loam was selected for the trial.

The same kind and the same amount of fertilizing ingredients were used in all cases, and the observations continued for three successive years. For details see Bulletin No. 47, April, 1897.

The variety of tobacco selected for the trial was Havana seed. For the purpose of securing uniformity of fertilizer during the years of the experiment, it was decided to purchase at once, as far as advisable, enough of each kind to supply the needed materials for three years.

Statement of Fertilizers used upon Different Plots.

The fertilizer mixture used during the entire time of observation contained in all cases, per acre : —

	Pounds.
Potassium oxide (available)	300
Nitrogen (available),	100
Phosphoric acid (available),	60

One-fourth of the nitrogen was in all cases used in the form of nitrates of soda or potash, to secure a uniform con-

dition of availability of nitrogen during the early stages of growth.

Each experiment plot measured 3,634 square feet, or approximately one-twelfth of one acre.

Chemical Composition of the Different Fertilizing Ingredients used in compounding the Special Fertilizers for Different Plots in the Tobacco Experiment. Ingredients containing Chlorine were carefully excluded from the Mixtures of Fertilizers in All Cases.

NAME OF MATERIAL.	Nitrogen.	Phosphoric Acid.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.
Nitrate of soda, ...	15.50	-	-	35.00	-	-
Nitrate of potash, ...	12.79	-	45.05	-	-	-
Cotton-seed meal, ...	6.50	3.17	2.25	-	-*	-*
Linseed meal, ...	5.91	1.95	1.08	-	-*	-*
Castor pomace, ...	5.60	2.26	3.40	-	-*	-*
Dissolved bone-black, ...	-	13.38	-	-	-*	-
Odorless phosphate, or phosphatic slag,	-	18.42	-	-	48.27	-
High-grade sulphate of potash, . .	-	-	50.20	-	-	-
Potash-magnesia sulphate, . . .	-	-	24.32	-	-	12.58
Cotton-seed hull ashes, ...	-	7.93	23.96	-	9.30	10.47
Carbonate of potash-magnesia, . .	-	-	18.48	-	-	19.52
Barn-yard manure, ...	.52	.39	.56	-*	-*	-*

* Not determined.

Chemical Composition of the Different Special Formulas used in the Tobacco Experiment.

PLOT 1.

NAME OF FERTILIZING MATERIAL USED.	Pounds per Acre.	POUNDS OF FERTILIZING ELEMENTS PER ACRE.		
		Phosphoric Acid.	Potassium Oxide.	Nitrogen.
Nitrate of potash, ...	195	-	88	25
Cotton-seed meal, ...	1,154	37	26	75
Dissolved bone-black, . . .	175	23	-	-
Potash-magnesia sulphate, . .	765	-	186	-
Total, ...	-	60	300	100

PLOT 2.

NAME OF FERTILIZING MATERIAL USED.	Pounds per Acre.	Pounds of Fertilizing Elements per Acre.		
		Phosphoric Acid.	Potassium Oxide.	Nitrogen.
Nitrate of potash,	195	-	88.0	25
Castor pomace,	1,340	31	45.0	75
Dissolved bone-black,	221	29	-	-
Potash-magnesia sulphate,	685	-	166.5	-
Total,	-	60	299.5	100

PLOT 3.

Nitrate of soda,	160.3	-	-	25
Cotton-seed meal,	1,154.0	37.00	26	75
Cotton-seed hull ashes,	1,142.0	90.56	274	-
Total,	-	127.56	300	100

PLOT 4.

Nitrate of soda,	160.3	-	-	25
Castor pomace,	1,340.0	31.0	45.50	75
Cotton-seed hull ashes,	1,060.0	84.1	253.97	-
Total,	-	115.1	299.47	100

[PLOT 5.—No manure at any time during the experiment.]

PLOT 6.

Nitrate of soda,	160.3	-	-	25
Cotton-seed meal,	1,154.0	37	26	75
Dissolved bone-black,	175.0	23	-	-
High-grade sulphate of potash,	545.8	-	274	-
Total,	-	60	300	100

PLOT 7.

Name of Fertilizing Material Used.	Pounds per Acre.	Pounds of Fertilizing Elements per Acre.		
		Phosphoric Acid.	Potassium Oxide.	Nitrogen.
Nitrate of soda, ...	160.3	-	-	25
Castor pomace, ...	1,340.0	31	45.50	75
Dissolved bone-black, . . .	221.0	29	-	-
High-grade sulphate of potash, .	506.0	-	254.50	-
Total, ...	-	60	300.00	100

PLOT 8.

Nitrate of soda, ...	160.3	-	-	25
Linseed meal, ...	1,271.0	24.78	14	75
Dissolved bone-black, . . .	263.0	35.22	-	-
High-grade sulphate of potash, .	569.7	-	286	-
Total, ...	-	60.00	300	100

PLOT 9.

Nitrate of potash, ...	195	-	88	25
Cotton-seed meal, ...	1,154	37	26	75
Cotton-seed hull ashes, . . .	776	62	186	-
Total, ...	-	99	300	100

PLOT 10.

Nitrate of potash, ...	195.0	-	88.00	25
Castor pomace, ...	1,340.0	31	45.50	75
Phosphatic slag meal, . . .	157.0	29	-	-
Carbonate of potash-magnesia, .	900.9	-	166.50	-
Total, ...	-	60	300.00	100

PLOTS 11 AND 12.*

Barn-yard manure, ...	20,000	78	112	104

* Average analysis of seventy-five samples tested at the station laboratory at Amherst, Mass.

Summary of Three Years of Observation at Hatfield, Agawam and Westfield.

I. *Number of Plants harvested and Yield of Tobacco per One Thousand Plants.*

Hatfield (Old Tobacco Land).

YEAR.	Average Number of Plants.		Difference in Yield per Plot on the Basis of 1,000 Plants (Pounds).	
	Per Plot.*	Per Acre.	Highest.	Lowest.
1893,	561	6,734	266	217
1894,	618	7,419	223	191
1895,	626	7,512	222	191

* One-twelfth of one acre.

Westfield (New Tobacco Land).

1894,	670	8,040	192	155
1895,	593	7,122	245	217
1896,	689	8,269	216	191

Agawam (New Tobacco Land).

1893,	696	8,352	225	158
1894,	704	8,432	220	164
1895,	695	8,340	222	148

YEAR.	Average Yield of Tobacco on the Basis of 1,000 Plants Harvested (Pounds).		
	Hatfield.	Westfield.	Agawam.
1893,	235.2	–	191.3
1894,	206.4	171.6	186.7
1895,	210.5	228.0	176.2
1896,	–	199.4	–

II. Average Yield of Tobacco, with Reference to Wrapper, per One Thousand Plants.

Hatfield.

YEAR.	Average Yield of Tobacco.	Average Yield of Wrappers.	Average Percentage of Wrappers.	Variations in Percentage of Wrappers in Plots.
	Pounds.	Pounds.		
1893, ...	235.2	97.2	41.2	21.0-71.0
1894, ...	206.6	105.0	50.7	38.8-64.4
1895, ...	210.1	109.3	52.1	36.8-63.1

Westfield.

1894, ...	171.3	90.3	52.3	41.6-62.10
1895, ...	228.7	49.6	21.2	6.4-34.40
1896, ...	199.3	138.2	69.6	59.0-78.80

Agawam.

1893, ...	190.8	-*	-*	-*
1894, ...	191.7	52.2	26.7	8.8-44.4
1895, ...	178.8	-*	-*	-*

* Not determined.

Conclusions drawn from the Third Year of Observation.

1. Good mechanical preparation of the soil and early application, and thus good diffusion of the fertilizers, not less than early planting and a suitable number of plants to a given area, exert a decided influence on the quantity and the quality of the crop, under otherwise corresponding conditions. Planting as early as the local climate admits secures the benefit of the winter moisture.

Too close planting interferes with a liberal or rapid development of the leaves, and too large open spaces between the

individual plants tends to favor a coarser structure. Rows three feet and four inches apart with plants twenty inches from each other in the row (Westfield), and rows two feet and eight inches apart with plants two feet from each other in the row (Hatfield) gave better returns than rows three feet apart with plants eighteen inches from each other in the row (Agawam).

2. A timely, shallow use of the cultivator or hoe for the removal of weeds favors a uniform progress of growth. A careless use of cultivator or hoe invariably checks more or less the growth of the plants, and modifies more or less their structure and general character.

3. The different fertilizer mixtures used in our experiments have affected in a less marked degree the weight of the crop raised by their aid than the quality. New lands reduced by previous cropping to a state approaching general exhaustion of available plant food, if otherwise well fitted for raising tobacco, have given excellent results when supplied with a suitable mixture of fertilizing ingredients in quantities similar to those applied during our experiments (Westfield). Such lands are at times preferable to old tobacco lands overcharged with remnants of all kinds of saline ingredients, usually associated with the common run of commercial fertilizers.

4. Cotton-seed meal, linseed meal and castor pomace have proved equally good sources of nitrogen for the successful raising of tobacco when used in connection with nitrate of soda or potash, sufficient to furnish one-fourth of the nitrogen called for by the crop.

5. Nitrate of soda as a part of the nitrogen supply in the fertilizer (25 per cent.), when used in presence of acid phosphate, dissolved bone-black, etc., has been accompanied with better results regarding quality of crop than nitrate of potash under otherwise similar conditions.

6. Cotton-seed hull ashes and high-grade sulphate of potash have proved in our observation most valuable sources of potash for tobacco, the former in the majority of cases leading. Nitrate of potash has produced excellent results when used in connection with an alkaline phosphate, as phosphatic slag meal or with carbonate of potash-magnesia. Our

results with potash-magnesia sulphate as the main potash sources of a tobacco fertilizer are not encouraging.

7. The difference noticed in the color of ash, etc., in case of the crop being raised upon different plots, is in several instances so slight that an attempt to classify the various fertilizers used with reference to their superior fitness on the basis of color and compactness of ash cannot be otherwise than arbitrary. With this qualification in mind, the following classification is offered for the consideration of parties engaged in the cultivation of tobacco in our section of the country: —

First Class.

Plot 4. — Nitrate of soda, cotton-seed hull ashes and castor pomace.

Plot 3. — Nitrate of soda, cotton-seed hull ashes and cotton-seed meal.

Plot 9. — Nitrate of potash, cotton-seed hull ashes and cotton-seed meal.

Plot 10. — Nitrate of potash, carbonate of potash-magnesia and phosphatic slag.

Second Class.

Plot 6. — Nitrate of soda, high-grade sulphate of potash, cotton-seed meal and dissolved bone-black.

Plot 8. — Nitrate of soda, high-grade sulphate of potash, linseed meal and dissolved bone-black.

Plot 7. — Nitrate of soda, high-grade sulphate of potash, castor pomace and dissolved bone-black.

Third Class.

Plot 1. — Nitrate of potash, potash-magnesia sulphate, cotton-seed meal and dissolved bone-black.

Plot 2. — Nitrate of potash, potash-magnesia sulphate, castor pomace and dissolved bone-black.

The observations with barn-yard manure have not been considered in the above classification; they are very encouraging, but not sufficient in number to permit detailed discussion in this connection; besides, the amount of barn-yard manure used in our experiment, ten tons per acre, contained nearly two hundred pounds of potassium oxide and

from thirty to forty pounds of available phosphoric acid less than our formula of commercial fertilizing ingredients called for.

An early application of barn-yard manure, properly supplemented with a suitable potash compound and available phosphoric acid, has produced excellent results in other localities.

INDEX.

PUBLIC DOCUMENT . . . . No. 51.

ANNUAL REPORT

OF THE

BOARD OF CATTLE COMMISSIONERS

OF THE

COMMONWEALTH OF MASSACHUSETTS,

IN ACCORDANCE WITH SECTION 51 OF CHAPTER 491 OF THE ACTS OF 1894.

JANUARY 11, 1898.

BOSTON:
WRIGHT & POTTER PRINTING CO., STATE PRINTERS,
18 POST OFFICE SQUARE
1898.

REPORT.

To the Honorable Senate and House of Representatives.

As provided for in section 51 of chapter 491 of the Acts of the year 1894, the Board of Cattle Commissioners hereby presents the following report of its work for the year 1897.

As was the case last year, the law of 1894 continued to be the basis of the work for the year 1897; and, as in 1896, the work has been continued under the following heads: —

First. — The supervision and direction of the work of the local inspectors appointed by the cities and towns under the provisions of chapter 491 of the Acts of 1894, and the examination of all animals quarantined by them as suspected of being afflicted with contagious disease.

Second. — The examination of cattle coming into the markets at Brighton, Watertown and Somerville from without the State for sale.

Third. — The examination and identification of cattle coming from without the State upon special permit.

Fourth. — The conduct of laboratory and stable experiments, to determine problems connected with the work of the Board.

Under section 1 of chapter 491 of the Acts of the year 1894, the mayor and aldermen of cities and the selectmen of towns must appoint one or more persons to be inspectors of animals and provisions. These inspectors must make regular and thorough inspection of all neat cattle, sheep and swine found within the limits of their several towns, when ordered to do so by the Board of Cattle Commissioners. They shall also make inspection of any domestic animal, whenever they have knowledge, or reason to believe, that such animal is affected with any contagious disease; and they shall also examine at the time of slaughter all neat cattle, sheep and swine slaughtered at slaughter houses licensed under the provision of this law.

The names of the inspectors appointed under this act are as follows: —

Abington,	John N. Chamberlain.
Acton,	Moses A. Reed.
Acushnet,	Philip A. Bradford.
Adams,	Andrew G. Potter.
Agawam,	Edwin Leonard.
Agawam,	Elijah D. Allen.
Alford,	Samuel K. Williams.
Amesbury,	Edward S. Worthen.
Amherst,	Henry E. Paige.
Andover,	Charles H Newton.
Arlington,	Alonzo S. Harriman.
Arlington,	Henry L. Alderman.
Ashburnham,	Charles W. Whitney, 2d.
Ashby,	Charles C. Damon.
Ashfield,	Walter G. Lesure.
Ashfield,	Homer S. Day.
Ashland,	Samuel D. Witt.
Ashland,	Edmund A. Stone.
Athol,	Oscar F. Stearns.
Attleborough,	Thomas L. Swift.*
Attleborough,	George Mackie.
Auburn,	Emory Stone.
Avon,	Charles E. May.
Ayer,	William H. Dudley.
Barnstable,	Alfred Crocker.
Barnstable,	John J. Harlow.
Barre,	John L. Smith.
Becket,	Lyman N. Cone.
Becket,	Edwin Lee.
Bedford,	Henry Wood.
Belchertown,	Guy C. Allen.
Bellingham,	Carroll E. White.
Belmont,	Benjamin A. Harris.
Berkley,	Eliphalet Terry.
Berlin,	Robert B. Wheeler.
Bernardston,	Charles Bowker.
Beverly,	Horace D. Lambert.
Billerica,	William H. Hutchins.
Blackstone,	Daniel H. Cooney.
Blackstone,	Elias M. Billings.
Blandford,	George Cadwell.
Blandford,	E. B. Gibbs.
Blandford,	Frank J. Candee.
Bolton,	Henry F. Haynes.

* Removed.

Boston, ...	Alexander Burr.
Boston, ...	J. C. Grouse.
Boston, ...	T. F. Kelley.
Boston, ...	George W. Roberts.
Bourne, ...	Noble P. Swift.
Boxborough, ...	Philip W. Cunningham.
Boxford, ...	Charles A. Andrew.
Boxford, ...	George B. Killam.
Boylston, ...	Luther S. Hapgood.
Braintree, ...	James M. Cutting.
Brewster, ...	Henry E. Baker.
Bridgewater, ...	Calvin Pratt.
Brimfield, ...	Porter A. Parker.
Brockton, ...	Simeon Mitchell.
Brockton, ...	Lucas W. Alden.
Brookfield, ...	George Allen.
Brookline, ...	Frederick H. Osgood.
Buckland, ...	Henry L. Warfield.
Burlington, ...	James N. Stuart.
Cambridge, ...	Charles E. Hadcock.
Canton, ...	Patrick J. Cronon.
Carlisle, ...	George P. Davis.
Carver, ...	Benjamin W. Robbins.
Charlemont, ...	William B. Avery.
Charlemont, ...	Horace Temple.
Charlton, ...	Stephen Hammond.
Chatham, ...	Isaac B. Young.
Chelmsford, ...	Edwin C. Perham.
Chelsea, ...	William Stinson.
Cheshire, ...	William P. Bennett.
Chester, ...	Daniel B. Holcomb.
Chester, ...	Edward L. Higgins.
Chesterfield, ...	George W. Rogers.
Chesterfield, ...	Clayton N. Rhoades.
Chicopee, ...	Thomas Goodwin.
Chicopee, ...	Irving H. Elmer.
Chilmark, ...	Freeman Hancock.
Clarksburg, ...	James Mixer.
Clinton, ...	Eugene H. Lehnert.
Cohasset, ...	Caleb F. Nichols.
Colrain, ...	C. Webster Smith.
Colrain, ...	H. Spencer Meacham.
Concord, ...	Horace Tuttle.
Conway, ...	Gordon H. Johnson.
Cottage City, ...	Edmund G. Beetle.
Cummington, ...	Edward F. Warner.
Cummington, ...	Myron D. Trow.
Cummington, ...	Finley V. Bates.
Dalton, ...	William Miller.

Dalton,	William C. Brague.
Dana,	Alfred W. Doane.
Danvers,	Charles S. Moore.
Dartmouth,	Charles W. Howland.
Dartmouth,	Charles H. Negus.
Dedham,	Edward Knobel, Jr.
Deerfield,	Dwight A. Hawks.
Deerfield,	Edward D. Jewett.
Dennis,	Edwin Whittemore.
Dennis,	Charles E. Baker.
Dighton,	Nathan O. Walker.
Dighton,	William H. Walker.
Dighton,	George A. Clark.
Douglas,	Edwin P. Heath.
Douglas,	James Dermody.
Dover,	James McGill.
Dracut,	William S. Eaton.
Dudley,	Monroe W. Ide.
Dunstable,	Franklin N. Tolles.
Duxbury,	George Bradford.
Duxbury,	John K. Parker.
East Bridgewater,	William T. Green.
East Longmeadow,	Edwin Indicott.
Eastham,	Reuben H. Horton.
Easthampton,	Fordyce Whitmarsh.
Easton,	Edward R. Hayward.
Edgartown,	Christopher R. Beetle.
Egremont,	William F. Crippen.
Enfield,	Albert R. House.
Enfield,	William H. Bush.
Erving,	Frank W. Loveland.
Essex,	C. Amos Burnham.
Essex,	Edward F. Knowlton.
Everett,	William Stinson
Fairhaven,	Ebenezer G. Grinnell.
Fall River,	Hilaire Bisaillon
Falmouth,	Barzillai C. Cahoon.
Falmouth,	Herbert H. Lawrence.
Fitchburg,	Otis F. Lord.
Florida,	Nathan W. Kemp.
Foxborough,	A. W. Draper.
Foxborough,	F. G. Lillyman.
Framingham,	Joseph G. E. Page.
Franklin,	William F. King.
Freetown,	Palo Alto Pierce.
Freetown,	James Webb.
Freetown,	Charles H. Read.
Gardner,	Augustus S. Cleaves.
Gardner,	Frank B. Page.

Gay Head, ...	Samuel J. Hasking.
Georgetown, ...	Samuel T. Poor.
Georgetown, ...	J. Winfred Yeaton.
Gill, ...	John L. S. Moore.
Gloucester, ...	Daniel G. Cressy.
Goshen, ...	Willis A. Smith.
Gosnold, ...	Josiah W. Tilton.
Grafton, ...	Perley Goddard.
Granby, ...	George L. Witt.
Granby, ...	C. D. Lyman.
Granville, ...	George W. Cone.
Granville, ...	Joseph Welch.
Great Barrington, . . .	Edwin Hurlburt.
Great Barrington, . . .	George H. Cobb.
Greenfield, ...	Mark L. Miner.
Greenwich, ...	Walter H. Glazier.
Groton, ...	Solon R. Dodge.
Groveland, ...	Thomas E. Snell.
Hadley, ...	Charles H. Hunt.
Hadley, ...	Homer L. Cowles.
Halifax, ...	Jabez P. Thompson.
Hamilton, ...	George E. F. Dane.
Hampden, ...	Moses H. Warren.
Hancock, ...	James S. Goold.
Hanover, ...	Edwin B. Dwelley.
Hanson, ...	Ezra White.
Hardwick, ...	John N. Hillman.
Harvard, ...	Mark A. Farnsworth.
Harwich, ...	John A. Baker.
Hatfield, ...	E. S. Warner.
Haverhill, ...	Grantley Bickell.
Haverhill, ...	Doane Cogswell.
Hawley, ...	L. W. Temple.
Heath, ...	V. D. Thompson.
Hingham, ...	Robert F. Robinson.
Hinsdale, ...	Frank C. Phillips.
Holbrook, ...	Z. P. Jordan.
Holden, ...	E. W. Merrick.
Holden, ...	W. A. Jordan.
Holden, ...	Allen Brown.
Holden, ...	Alvin Thurston.
Holland, ...	A. J. Bagley.
Holliston, ...	Isaac A. Smith.
Holyoke, ...	Bernard F. Bigelow.
Hopedale, ...	Waldo Phipps.
Hopkinton, ...	Winslow W. Claflin.
Hubbardston, ...	John H. Burtch.
Hudson, ...	A. L. Cundall.

Hull, ...	Harvey T. Litchfield.*
Hull, ...	Darius W. Gilbert.
Huntington, ...	Heman Burr.
Huntington, ...	Fred W. Lyman.
Hyde Park, ...	Joseph M. Kiggen.
Ipswich, ...	Daniel S. Appleton.
Kingston, ...	E. Elbridge Atwood.
Lakeville, ...	Isaac Sampson.
Lancaster, ...	Henry F. Hosmer.
Lancaster, ...	A. W. Carr.
Lanesborough, ...	William P. Talcott.
Lawrence, ...	John F. Winchester.
Lawrence, ...	Valentine T. Sellers.
Lee, ...	John H. McAllister.
Leicester, ...	Henry B. Watts.
Lenox, ...	Charles C. Flint.
Leominster, ...	George M. Kendall.
Leverett, ...	O. C. Marvell.
Lexington, ...	Charles M. Parker.
Leyden, ...	Ezra Foster.*
Leyden, ...	Albert J. Shattuck.
Lincoln, ...	Roger Sherman.
Littleton, ...	Joseph N. Murray.
Longmeadow, ...	Spencer W. Gates.
Lowell, ...	Walter A. Sherman.
Ludlow, ...	Adelbert L. Bennett.
Lunenburg, ...	Charles E. Woods.
Lunenburg, ...	Micah M. Boutwell.
Lynn, ...	William E. Welts.
Lynnfield, ...	William R. Roundy.
Malden, ...	James H. Kimball.
Manchester, ...	John Riordan.
Mansfield, ...	Joseph N. Tebbetts.
Marblehead, ...	Benjamin F. Martin, Jr.
Marion, ...	George F. Richards.
Marlborough, ...	Patrick J. Mahoney.
Marshfield, ...	Franklin W. Hatch.
Mashpee, ...	Darius Coombs.
Mattapoisett, ...	David H. Cannon.
Maynard, ...	Joel F. Parmenter.
Medfield, ...	Francis D. Hamant.
Medford, ...	Henry F. Moore.
Medway, ...	Edward Whiting.
Melrose, ...	F. P. Sturges.
Mendon, ...	Albert W. Gaskill.
Merrimac, ...	Charles A. Wallace.
Methuen, ...	Edwin J. Castle.

* Deceased.

Middleborough, ...	James A. Burgess.
Middlefield, ...	John T. Bryan.
Middleton, ...	Andrew W Peabody.
Milford, ...	Waldo Phipps.
Millbury, ...	Henry W. Carter.
Millis, ...	Moses C. Adams.
Milton, ...	James Spencer.
Monroe, ...	A. H. Goldthwait.
Monson, ...	William H. Bugbee.
Monson, ...	Hiram D. Osborne.
Montague, ...	G. H. Goddard.
Montague, ...	F. H. Giles.
Monterey, ...	Lewis H. Mallory.
Montgomery, ...	Willis B. Cushman.
Mount Washington, . . .	Alfred I. Spurr.
Nahant, ...	Robert L. Cochran.
Nantucket, ...	Albert Easton.
Natick, ...	Walter P. Mayo.
Needham, ...	Samuel O. Fowle.
New Ashford, ...	Van Ness Mallery.
New Bedford, ...	Daniel C. Ashley.
New Braintree, ...	Charles A. Felton.
New Marlborough, . . .	George A. Stevens.
New Marlborough, . . .	Lorin P. Keyes.
New Salem, ...	Willard Putnam.
Newbury, ...	Asa Pingree.
Newburyport, ...	George W. Knight.
Newton, ...	James R. McLaughlin.
Norfolk, ...	Andrew R. Jones.
North Adams, ...	Angus A. McDonnel.
North Andover, ...	George S. Fuller.
North Attleborough, . . .	W. Henry Kling.
North Attleborough, . . .	G. B. Draper.
North Attleborough, . . .	Asa A. Newell.
North Brookfield, . . .	B. F. Barnes.
North Brookfield, . . .	Alfred O. Boyd.
North Reading, ...	F. Howard Mosman.
Northampton, ...	John H. Roberts.
Northborough, ...	Allyn D. Phelps.
Northbridge, ...	George F. Nilsson.
Northbridge, ...	R. H. Baton.
Northbridge, ...	W. A. Beane.
Northbridge, ...	John Lincoln.
Northfield, ...	R. C. Ward.
Norton, ...	Oren E. Walker.
Norton, ...	Lester D. Blandin.
Norwell, ...	J. Warren Foster.
Norwell, ...	Edwin C. Briggs.
Norwell, ...	Ashburton W. Pinson.

Norwood,	Albert Fales.
Oakham,	Henry P Austin.
Orange,	Amos Blodgett.
Orleans,	Edmund Linnell.
Otis,	Edwin L. Downs.
Otis,	Alfred D. Jones.
Oxford,	Fred L. Snow.
Oxford,	Willis Rosebrooks.
Palmer,	Charles F. Smith.
Palmer,	E. W. Phinney.
Paxton,	Hiram P. Bemis.
Peabody,	Charles Davis.
Peabody,	Cyrus T Batchelder.
Peabody,	John E. Herrick.
Pelham,	John A. Page.
Pembroke,	Clifford I. Rogers.
Pepperell,	Samuel P. Bancroft.
Peru,	Henry Barlow.
Petersham,	S. C. Goddard.
Phillipston,	Robert E. McLane.
Pittsfield,	George N. Kinnell.
Plainfield,	Daniel H. Gould.
Plainfield,	Edwin A. Atkins.
Plymouth,	Clark Finney, Jr.
Plympton,	Howard O. Bonney.
Prescott,	Elmer M. Aiken.
Prescott,	James D. Barnes.
Prescott,	Mason W. Haskins.
Princeton,	George Mason, Jr.
Provincetown,	Daniel F. Lewis.
Quincy,	Charles H. Johnson.
Randolph,	Augustus L. Chase.
Raynham,	Cyrus Leonard, 2d.
Reading,	Milton D. Parker.
Rehoboth,	Clarence J. Kingsbury.
Rehoboth,	Albert R. Lewis.
Rehoboth,	John W. Chase.
Revere,	Edwin S. Plaisted.
Richmond,	W. H. Branch.
Rochester,	Allen G. Ashley.
Rockland,	Charles Winslow.
Rockport,	Alvin Sanborn.
Rowe,	E. M. Upton.
Rowley,	Daniel H. Hale.
Rowley,	J. Scott Todd.
Royalston,	George E Peirce.
Russell,	Sidney S Shurtleff.
Rutland,	F. G. Bartlett.
Salem,	Fred Saunders.

Salisbury, ...	N. T. Getchell.
Sandisfield, ...	Henry S. Manley.
Sandisfield, ...	Charles H. Callender.
Sandisfield, ...	Hiram Bliss.
Sandwich, ...	Samuel H. Nye.
Saugus, ...	A. W. Sawyer.
Savoy, ...	L. E. Perry.
Savoy, ...	Milton A. Bliss.
Scituate, ...	Caleb L. Damon.
Seekonk, ...	Lowell M. Cole.
Seekonk, ...	Robert Woodward.
Seekonk, ...	Olney Greene.
Sharon, ...	A. W. Draper.
Sharon, ...	George Richards.
Sheffield, ...	Henry Clark.
Sheffield, ...	Edwin L. Boardman.
Shelburne, ...	William M. Bardwell.
Shelburne, ...	B. F. Maxwell.
Shelburne, ...	T. R. Shearer.
Sherborn, ...	Jasper J. Smart.
Shirley, ...	Samuel B. Scott.
Shrewsbury, ...	David Barnes.
Shutesbury, ...	Oscar H. Shaw.
Somerset, ...	Thomas A. Francis.
Somerville, ...	Charles M. Berry.
South Hadley, ...	Horace W. Gaylord.
Southampton, ...	Henry E. Coleman.
Southampton, ...	Michael Norris.
Southborough, ...	William H. Buck.
Southbridge, ...	Henry A. Morse.
Southbridge, ...	Francis H. Olin.
Southwick, ...	Charles W. Talmadge.
Spencer, ...	Abraham Capen.
Springfield, ...	James Kimball.
Sterling, ...	William S. Walker.
Stockbridge, ...	John M. Buck.
Stockbridge, ...	Marshall S. Heath.
Stoneham, ...	George H. Allen.
Stoughton, ...	James Murphy.
Stow, ...	Lewis Parks.
Sturbridge, ...	William Whittemore.
Sudbury, ...	George A. Haynes.
Sudbury, ...	Hiram Haynes.
Sunderland, ...	George P. Smith.
Sutton, ...	Edward A. Welch.*
Sutton, ...	P. D. King.
Swampscott, ...	Samuel A. Spaulding.†
Swampscott, ...	George Newhall.

* Deceased. † Resigned.

Swanzey,	Arthur W. Weaver.
Swanzey,	David B. Gardner.
Swanzey,	Anson L. Barney.
Taunton,	Walter H. Haskell.
Templeton,	S. E. Greenwood.
Templeton,	W. F. Robie.
Tewksbury,	George W. Trull.
Tisbury,	Henry C. Norton.
Tolland,	Oliver E. Slocum, Jr.
Topsfield,	E. L. Wildes.
Topsfield,	Benjamin A. Orne.
Townsend,	John N. Going.
Truro,	John G. Thompson.
Tyngsborough,	Henry J. Keyes.
Tyringham,	Joseph Jones.
Upton,	Benjamin A. Jourdan.
Upton,	George D. Whitney.
Uxbridge,	Charles E. Seagraves.
Wakefield,	Henry C. Perry.
Wales,	Warren W. Eager.
Walpole,	George S. Fuller.*
Walpole,	Isaac Miller.
Waltham,	William E. Peterson.
Ware,	A. A. Etienne.
Wareham,	Prince H Swift.
Warren,	Marcus Burroughs.
Warwick,	Gilbert Maynard.
Washington,	Charles E. Shultz.
Watertown,	George W. Pope.
Wayland,	Thomas Bryant.
Webster,	George F. Hart.
Wellesley,	Samuel O. Fowle.
Wellfleet,	George W. Nickerson.
Wendell,	G. A. Lewis
Wenham,	Henry Alley.
West Boylston,	John F. Knights.
West Bridgewater,	David R. Simmons.
West Brookfield,	Charles E. Smith.
West Newbury,	Alfred L. Moore.
West Springfield,	Henry A. Sibley.
West Springfield,	Ethan Brooks.†
West Springfield,	M. H. Bidwell.
West Stockbridge,	Ralph R. Bissell.
West Tisbury,	William B. Luce.
Westborough,	Henry A. Gilmore.
Westfield,	Michael F. Hoar.
Westford,	George T. Day.
Westford,	Albert P. Richardson.

* Deceased. † Declined.

Westhampton, ...	William J. Lyman.
Westhampton, ...	A. D. Montague, Jr.
Westminster, ...	M. D. Whitney.
Westminster, ...	Edward P. Miller.
Weston, ...	Gilbert W. Blood.
Weston, ...	Everett O. Clark.
Westport, ...	Edward S. Smith.
Westport, ...	Theodore B. Pierce.
Westwood, ...	Creighton Colburn.
Weymouth, ...	Hiram E. Raymond.
Weymouth, ...	Charles E. Bicknell.
Whately, ...	Irving Allis.
Whitman, ...	Owen F. Bumpus.
Wilbraham, ...	Lyman A. Fisk.
Williamsburg, ...	George W. Lawley.*
Williamsburg, ...	Hallock H. Nichols.
Williamstown, ...	Joseph B. Hill.
Wilmington, ...	H. Allen Sheldon.
Winchendon, ...	William A. Deland.
Winchester, ...	William B. Simonds.
Windsor, ...	Gardner L. Miner.
Windsor, ...	H. Ward Ford.
Winthrop, ...	John McNaught.
Woburn, ...	James N. Stuart.
Worcester, ...	J. Warren Ellsworth.
Worcester, ...	Thomas Monahan.
Worcester, ...	John P. Streeter.
Worthington, ...	Horace F. Bartlett.
Wrentham, ...	Elisha M. Brastow.
Wrentham, ...	George B. Ware.
Yarmouth, ...	Isaiah Homer.
Yarmouth, ...	James Lack.
Yarmouth, ...	Isaiah Crowell.

It had previously been the custom of the Board to order the inspectors to make the regular inspection in the fall of the year. This had been found unsatisfactory, as in a great many instances it is the custom for the owners to leave their cattle out until late in the fall, and it frequently happened that at the time of the inspection all the animals had not been taken up from pasture. Because of this, the Board did not think it possible that the work could be done by the inspectors without passing over many animals; but, as the Legislature did not grant the appropriation until late in the season, it had been found impossible to make a change.

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* Resigned.

During the past year, however, the Board was granted the appropriation much earlier, and in consequence of this they were enabled to change the time of inspection from fall to spring. As a result of this change they were able to make a more thorough inspection at a time when such animals as were affected would be apt to show the effects of their winter's confinement, and when it was also possible to find them all on the owner's premises. Consequently, on March 9 the following letter was sent to each inspector, instructing him to make an immediate general inspection of the animals within the limits of his district: —

COMMONWEALTH OF MASSACHUSETTS.

Board of Cattle Commissioners,
Commonwealth Building, Boston, March 9, 1897.

Dear Sir: — Section 4, chapter 491 of the Acts of 1894, as amended by section 1, chapter 496 of the Acts of 1895, provides that "inspectors shall make regular and thorough inspections of all neat cattle, sheep and swine found within the limits of their several cities and towns. Such inspection shall be made at such times and in such manner as the Board of Cattle Commissioners shall from time to time determine and direct." This section also provides that "inspectors shall immediately inspect all domestic animals, and any barn, stable or premises where such animals are kept, whenever directed to do so by the Board of Cattle Commissioners."

Believing that a complete general inspection made at this time would be more satisfactory than one made in the fall, when many animals might be still in pasture, and in accordance with the above authority conferred on us, the Board of Cattle Commissioners hereby order an immediate inspection of all neat cattle, sheep and swine, and all barns, stables and premises where such animals are kept in their several districts. Such inspection is to begin at this date and to be carried on with all possible despatch until finished, or until the first day of May, 1897, when such inspection is hereby ordered closed. The returns of this inspection will be made on the blank form provided, and such returns must be sent to this office each week until completed.

It is further recommended that inspectors ascertain the whereabouts of a number of cattle which they think should be quarantined, and then serve a number of quarantine orders on one day, so as to send us several quarantines at one time, rather than one

or two a day, extended over a period of two or three weeks, as it is much less expensive to send an agent to test a number of animals at one time than it is to send the same agent a number of times to test the same lot of animals.

We also call the notice of inspectors to the regulations for cleansing and disinfecting, which they must see are strictly carried out by the owners or occupants of all premises from which cattle are removed by order of the Board of Cattle Commissioners.

Specimens to be examined, dogs to be tested for the diagnosis of rabies, and the like, are hereafter to be sent by express to Dr. Langdon Frothingham, Harvard Medical School, 688 Boylston Street, Boston, Mass. In every case the name and address of the owner of the animal, with the history of the case, should be enclosed with the specimen.

Yours truly, AUSTIN PETERS, *Chairman.*

The work of the inspectors having been ordered completed by May 1, the following letter, dated May 12, was sent to those inspectors who had not brought their work to a close: —

COMMONWEALTH OF MASSACHUSETTS.

BOARD OF CATTLE COMMISSIONERS,
BOSTON, MASS., May 12, 1897.

To the Town Inspector of Cattle.

SIR: — We desire to call your attention to our letter of March 9, ordering an inspection of cattle to be completed May 1.

In towns where the inspection was completed on this date, we wish to thank the inspectors for their promptness; where such inspection is not completed, we wish it brought to a close without further delay. No more cattle are to be quarantined until another inspection is ordered, unless some one reports a badly diseased creature to the Board of Health.

The inspectors of border towns are also requested to bear in mind the provisions of General Order No. 9, requiring that cattle brought in from without the State, which have not already been tested with tuberculin in a manner satisfactory to the Board of Cattle Commissioners, are to be held in quarantine at the expense of the owner until tested with tuberculin at his expense by a veterinarian acceptable to this Board.

Per order Massachusetts Board of Cattle Commissioners,
AUSTIN PETERS, *Chairman.*

This letter was sent out for the purpose of stopping the *general inspection;* but, while it was intended to close this

inspection, it was of course still possible for the inspector to quarantine such animals as were reported in writing as diseased to the local board of health, and this class of work has gone on all summer.

The following table gives the number of cattle assessed in each town, the total number of cattle tested, and the number condemned and paid for during the year, as well as the State tax for each town in the Commonwealth: —

CITY OR TOWN.	Neat Cattle Assessed.	Number Tested.	Number Paid for.	Amount Paid.	State Tax.
Abington,	254	14	5	$153 00	$1,750 00
Acton,	1,175	144	127	4,751 50	1,050 00
Acushnet,	449	9	3	75 00	437 50
Adams,	689	18	2	75 00	2,695 00
Agawam,	2,315	17	17	395 00	945 00
Alford,	275	7	4	125 00	157 50
Amesbury,	381	39	25	727 50	3,657 50
Amherst,	1,696	34	18	431 25	2,222 50
Andover,	913	87	50	1,980 00	3,430 00
Arlington,	257	12	-	-	5,653 00
Ashburnham,	431	34	25	764 75	752 50
Ashfield,	1,269	7	5	190 00	367 50
Ashby,	570	60	36	1,128 00	367 50
Ashland,	309	23	16	516 50	857 50
Athol,	514	16	5	205 00	2,642 50
Attleborough,	776	36	24	654 00	3,220 00
Avon,	109	1	-	-	542 50
Ayer,	113	1	1	7 00	962 50
Auburn,	826	1	2	60 00	402 50
Barnstable,	584	4	2	13 00	2,695 00
Barre,	1,995	58	30	924 50	1,032 50
Becket,	642	-	-	-	332 50
Bedford,	627	21	17	495 00	682 50
Belchertown,	1,959	18	9	227 00	630 00
Bellingham,	524	37	19	584 50	490 00
Belmont,	215	7	2	38 00	2,642 50
Berkley,	403	-	-	-	315 00
Berlin,	555	9	5	137 50	350 00
Bernardston,	797	15	10	287 50	297 50
Beverly,	595	4	2	50 00	10,132 50
Billerica,	809	195	133	5,677 51	1,382 50
Blackstone,	351	-	-	-	1,890 00
Blandford,	955	26	9	243 00	312 00
Bolton,	758	54	46	1,353 00	332 50
Boston,	400	288	98	3,557 99	628,740 00
Bourne,	174	-	-	-	172 50
Boxborough,	532	52	42	1,418 00	157 50
Boylston,	741	6	3	75 00	350 00
Boxford,	555	19	16	457 50	437 50
Braintree,	404	-	-	-	3,115 00
Brewster,	188	-	-	-	437 50
Bridgewater,	464	10	4	185 00	1,767 50
Brimfield,	1,033	24	20	581 50	297 50
Brockton,	696	55	29	1,012 25	15,085 00
Brookfield,	803	1	1	5 00	1,050 00
Brookline,	361	5	3	115 00	41,632 50
Buckland,	736	2	2	55 00	420 00
Burlington,	478	8	6	210 00	350 00
Cambridge,	262	1	1	30 00	54,600 00

CITY OR TOWN.	Neat Cattle Assessed.	Number Tested.	Number Paid for.	Amount Paid.	State Tax.
Canton,	374	9	7	$267 00	$3,027 50
Carlisle,	513	326	195	8,700 00	245 00
Carver,	164	-	-	-	577 00
Charlemont,	732	13	4	73 50	280 00
Charlton,	1,595	30	24	682 00	682 50
Chatham,	177	-	-	-	665 00
Chelmsford,	1,100	209	136	4,769 00	1,452 50
Chelsea,	82	2	-	-	15,802 50
Cheshire,	998	4	2	27 00	525 00
Chester,	650	1	1	20 00	455 00
Chesterfield,	696	18	8	269 00	210 00
Chicopee,	594	16	10	312 00	5,810 00
Chilmark,	152	-	-	-	157 50
Clarksburg,	355	-	-	-	175 00
Clinton,	150	-	-	-	4,865 00
Cohasset,	297	-	-	-	3,360 00
Colrain,	1,317	49	7	163 00	420 00
Concord,	1,428	129	98	3,170 00	2,940 00
Conway,	1,293	79	48	1,426 00	507 50
Cottage City,	111	-	-	-	980 00
Cummington,	645	47	26	894 50	227 50
Dalton,	448	11	2	75 00	2,047 50
Dana,	250	1	-	-	210 00
Danvers,	745	27	23	922 00	3,150 00
Dartmouth,	1,752	3	3	60 00	1,890 00
Dedham,	486	42	25	722 50	4,602 50
Deerfield,	1,231	78	29	882 00	1,155 00
Dennis,	198	-	-	-	1,172 50
Dighton,	360	5	4	95 00	595 00
Douglas,	334	4	1	20 00	735 00
Dover,	622	21	12	350 00	682 00
Dracut,	950	163	155	5,899 00	1,172 50
Dudley,	906	15	12	276 00	787 50
Dunstable,	661	13	7	190 50	210 00
Duxbury,	290	8	1	15 00	1,102 50
East Bridgewater,	531	19	8	212 00	1,155 00
East Longmeadow,	525	6	3	63 00	490 00
Eastham,	181	-	-	-	210 00
Easthampton,	741	9	5	132 50	1,750 00
Easton,	659	7	4	90 00	3,552 50
Edgartown,	324	-	-	-	525 00
Egremont,	851	14	7	244 00	332 50
Enfield,	514	1	-	-	560 00
Erving,	170	-	-	-	280 00
Essex,	487	-	-	-	700 00
Everett,	133	8	-	-	8,610 00
Fairhaven,	440	-	-	-	1,382 50
Fall River,	591	14	4	62 50	43,540 00
Falmouth,	422	3	-	-	4,287 50
Fitchburg,	761	32	24	800 00	13,860 00
Florida,	358	-	-	-	122 50
Foxborough,	361	14	4	85 00	1,190 00
Framingham,	1,056	60	36	1,387 00	6,527 50
Franklin,	701	40	21	549 00	2,100 00
Freetown,	591	4	-	-	630 00
Gardner,	461	212	86	3,221 50	3,552 50
Gay Head,	56	-	-	-	17 50
Georgetown,	276	-	-	-	752 50
Gill.	678	35	12	374 00	332 50
Gloucester,	550	2	-	-	11,375 00
Goshen,	382	3	1	23 00	105 00
Gosnold,	51	-	-	-	140 00
Grafton,	1,118	79	34	1,134 50	1,732 50
Granby,	1,296	63	41	1,031 50	332 50
Granville,	661	15	-	-	262 50
Great Barrington,	1,517	10	5	115 00	2,572 50
Greenfield,	1,084	108	61	2,102 50	3,727 50

CITY OR TOWN.	Neat Cattle Assessed.	Number Tested.	Number Paid for.	Amount Paid.	State Tax.
Greenwich,	341	12	6	$173 00	$192 50
Groton,	993	45	33	1,068 50	2,047 50
Groveland,	226	2	1	40 00	700 00
Hadley,	1,484	18	9	178 00	735 00
Halifax,	149	1	1	15 00	192 50
Hamilton,	372	1	-	-	752 50
Hampden,	601	11	3	75 00	280 00
Hancock,	604	8	2	60 00	245 00
Hanover,	286	3	-	-	1,015 00
Hanson,	164	2	1	39 00	455 00
Hardwick,	1,887	86	40	1,159 00	1,085 00
Harvard,	1,316	105	66	2,228 50	717 50
Harwich,	189	-	-	-	875 00
Hatfield.	439	3	2	43 00	735 00
Haverhill,	894	76	42	1,374 00	14,735 00
Hawley,	576	-	1	22 50	122 50
Heath,	722	25	9	234 00	140 00
Hingham,	506	1	-	-	3,167 50
Hinsdale,	695	-	-	-	542 50
Holden,	694	-	-	-	845 00
Holbrook,	147	-	-	-	945 00
Holland,	131	14	9	233 50	70 00
Holliston,	708	7	5	164 00	1,207 50
Holyoke,	602	18	5	185 00	19,040 00
Hopedale,	106	10	4	152 00	1,820 00
Hopkinton,	735	51	31	1,107 50	1,470 00
Hubbardston,	933	32	19	609 50	490 00
Hudson,	735	14	8	330 00	2,082 50
Hull,	79	1	1	40 00	1,820 00
Huntington,	517	21	4	122 50	385 00
Hyde Park,	116	6	2	55 00	5,932 50
Ipswich,	935	6	9	202 00	2,065 00
Kingston,	205	5	2	38 00	1,172 50
Lakeville,	376	7	4	98 00	402 50
Lancaster,	622	41	24	816 00	2,082 50
Lanesborough,	870	48	41	1,320 00	367 50
Lawrence,	169	20	13	535 00	23,240 00
Lee,	721	90	3	70 00	1,295 00
Leicester,	536	3	3	80 00	1,645 00
Lenox,	638	39	20	600 00	2,082 50
Leominster,	723	96	69	2,431 00	3,990 00
Leverett,	455	1	-	-	210 00
Lexington,	1,044	119	106	4,067 50	2,052 50
Leyden,	470	36	7	204 64	122 50
Lincoln,	775	123	95	3,599 00	1,610 00
Littleton,	1,223	70	35	1,217 00	612 50
Longmeadow,	281	21	18	494 00	437 50
Lowell,	280	43	32	1,448 50	49,000 00
Ludlow,	1,039	30	18	493 00	752 50
Lunenburg,	633	54	31	847 00	560 00
Lynn,	227	53	4	117 00	34,667 00
Lynnfield,	287	18	1	8 00	420 00
Malden,	161	-	-	-	17,307 00
Manchester,	86	-	-	-	4,970 00
Mansfield,	226	5	-	-	1,277 50
Marblehead,	294	4	3	73 00	4,042 50
Marion,	116	-	-	-	577 50
Marlborough,	841	17	15	652 00	5,792 50
Marshfield,	530	38	14	420 50	945 00
Mashpee,	36	-	-	-	122 50
Mattapoisett,	225	2	2	45 00	1,050 00
Maynard,	229	106	102	3,987 50	1,470 00
Medfield,	508	2	2	95 00	997 50
Medford,	303	1	2	45 00	10,902 50
Medway,	435	9	6	175 00	927 50
Melrose,	222	1	1	40 00	6,877 50
Mendon,	567	12	8	161 00	385 00

CITY OR TOWN.	Neat Cattle Assessed	Number Tested.	Number Paid for.	Amount Paid.	State Tax.
Merrimac, ...	281	6	2	$25 00	$945 00
Methuen, ...	1,347	67	40	1,311 00	2,467 50
Middleborough, . .	664	15	11	375 00	2,975 00
Middlefield, . . .	469	1	-	-	175 00
Middleton, . . .	246	12	6	133 00	367 50
Milford, ...	405	5	2	75 00	3,867 50
Millbury, ...	730	15	10	289 50	1,680 00
Millis, ...	509	3	3	100 00	595 00
Milton, ...	871	4	2	27 00	13,737 50
Monroe, ...	155	-	-	-	105 00
Monson, ...	1,280	13	7	180 00	1,400 00
Montague, . . .	777	59	7	232 50	2,555 00
Monterey, . . .	536	2	-	-	175 00
Montgomery, . .	356	-	-	-	105 00
Mount Washington, .	78	-	-	-	52 50
Nahant, ...	44	-	-	-	4,042 50
Nantucket, . . .	512	-	-	-	2,117 50
Natick, ...	495	56	45	1,726 50	3,990 00
Needham, ...	638	9	6	172 75	1,977 50
New Ashford, . .	134	-	-	-	52 50
New Bedford, . .	581	2	1	50 00	36,067 50
New Braintree, . .	1,315	17	9	162 00	297 50
New Marlborough, .	134	17	5	104 00	402 50
New Salem, . . .	369	4	2	45 50	227 50
Newbury, ...	1,078	1	1	30 00	752 50
Newburyport, . .	249	43	43	1,378 00	7,857 50
Newton, ...	1,176	510	35	1,189 00	32,077 50
Norfolk, ...	344	32	21	795 00	367 50
North Adams, . .	1,611	-	-	-	5,477 50
North Andover, . .	1,286	119	89	3,289 00	2,363 50
North Attleborough, .	591	30	24	692 50	2,800 00
North Brookfield, .	954	20	10	256 50	1,400 00
North Reading, . .	293	32	23	815 00	367 50
Northampton, . .	966	49	8	228 49	7,315 00
Northborough, . .	803	61	28	745 00	892 50
Northbridge, . .	495	12	4	98 00	2,537 50
Northfield, . . .	1,056	2	-	-	682 50
Norton, ...	352	3	1	40 00	577 50
Norwell, ...	255	5	4	70 00	670 00
Norwood, ...	372	15	10	367 00	2,152 50
Oakham, ...	641	16	10	231 50	245 00
Orange, ...	795	35	19	546 00	2,817 50
Orleans, ...	168	1	-	-	490 00
Otis, ...	604	-	-	-	157 50
Oxford, ...	569	9	4	105 00	927 50
Palmer, ...	789	12	8	235 00	2,030 00
Paxton, ...	396	6	5	70 50	192 50
Peabody, ...	658	52	26	1,185 00	5,477 50
Pelham, ...	215	2	1	25 00	122 50
Pembroke, . . .	166	8	1	18 00	472 50
Pepperell, . . .	813	83	19	559 00	1,435 00
Peru, ...	353	10	1	25 00	87 50
Petersham, . . .	612	31	10	267 50	455 00
Phillipston, . . .	351	35	6	127 00	210 00
Pittsfield, ...	1,155	49	10	322 00	9,415 00
Plainfield, . . .	565	3	2	47 00	122 50
Plymouth, . . .	401	12	6	157 50	4,620 00
Plympton, . . .	109	-	-	-	227 50
Prescott, ...	399	3	2	17 50	122 50
Princeton, . . .	1,240	155	85	2,953 00	577 50
Provincetown, . .	61	-	-	-	1,592 50
Quincy, ...	642	6	3	100 00	11,777 50
Randolph, . . .	192	-	-	-	1,645 00
Raynham, ...	407	10	7	185 00	630 00
Reading, ...	409	4	1	35 00	2,450 00
Rehoboth, . . .	1,269	25	12	327 50	525 00
Revere, ...	119	-	-	-	4,585 00

CITY OR TOWN.	Neat Cattle Assessed.	Number Tested.	Number Paid for.	Amount Paid.	State Tax.
Richmond, ...	448	-	-	-	$245 00
Rochester, ...	295	4	-	-	385 00
Rockland, ...	209	1	-	-	2,170 00
Rockport, ...	145	-	-	-	1,845 00
Rowe, ...	409	-	-	-	175 00
Rowley, ...	483	3	3	$90 00	490 00
Royalston, ...	619	39	24	732 00	437 50
Russell, ...	148	24	15	539 00	350 00
Rutland, ...	848	60	38	912 00	367 50
Salisbury, ...	421	23	5	145 00	465 00
Salem, ...	327	16	13	389 50	20,475 00
Sandisfield, ...	766	43	18	577 00	245 00
Sandwich, ...	214	11	3	80 00	682 50
Saugus, ...	656	-	-	-	2,065 00
Savoy, ...	592	19	2	41 00	122 50
Scituate, ...	345	1	-	-	1,435 00
Seekonk, ...	1,019	23	12	324 00	612 50
Sharon, ...	338	18	13	405 00	1,137 50
Sheffield, ...	592	8	2	61 00	630 00
Shelburne, ...	1,210	26	2	60 00	647 50
Shutesbury, ...	130	-	-	-	122 50
Sherborn, ...	742	16	15	449 50	577 50
Shirley, ...	409	13	6	119 00	525 00
Shrewsbury, . . .	1,267	2	1	26 00	700 00
Somerset, ...	387	2	1	20 00	752 50
Somerville, ...	200	9	2	50 00	30,205 00
South Hadley, . . .	1,070	20	3	80 00	1,645 00
Southampton, . . .	1,027	10	9	260 00	350 00
Southborough, . . .	1,085	33	24	686 00	1,137 50
Southbridge, . . .	786	26	21	856 50	2,852 50
Southwick, ...	802	1	1	12 50	385 00
Spencer, ...	1,089	27	22	560 00	2,922 50
Springfield, ...	400	28	13	462 50	41,072 50
Sterling, ...	1,491	94	61	1,661 66	612 50
Stockbridge, . . .	1,671	28	20	697 00	2,170 00
Stoneham, ...	233	8	8	308 00	2,835 00
Stoughton, ...	368	2	2	55 00	2,117 50
Stow, ...	857	107	86	2,858 00	455 00
Sturbridge, ...	770	14	4	92 00	682 50
Sudbury, ...	1,075	361	353	14,328 58	822 50
Sunderland, ...	775	60	17	558 00	297 50
Sutton, ...	962	75	45	1,418 50	945 00
Swampscott, . . .	79	28	10	376 50	3,955 00
Swanzey, ...	926	1	-	-	612 50
Taunton, ...	762	8	-	-	13,965 00
Templeton, ...	506	52	14	469 50	980 00
Tewksbury, ...	531	87	17	615 00	1,050 00
Tisbury, ...	33	-	-	-	577 50
Tolland, ...	426	4	-	-	105 00
Topsfield, ...	684	17	13	515 00	612 50
Townsend, ...	418	27	13	384 50	840 00
Truro, ...	195	-	-	-	262 50
Tyngsborough, . . .	415	28	20	701 00	280 00
Tyringham, ...	801	7	1	28 00	157 50
Upton, ...	548	4	3	87 00	735 00
Uxbridge, ...	712	19	6	180 00	1,592 50
Wakefield, ...	270	1	1	35 00	4,095 00
Wales, ...	250	2	-	-	210 00
Walpole, ...	523	12	9	317 50	1,452 50
Waltham, ...	770	77	70	2,614 50	13,055 00
Ware, ...	941	14	7	144 00	3,097 50
Wareham, ...	191	1	-	-	1,170 00
Warren, ...	1,422	19	7	167 50	1,960 00
Warwick, ...	275	5	1	14 00	227 50
Washington, . . .	518	5	3	125 00	140 00
Watertown, ...	247	23	7	262 00	5,705 00
Wayland, ...	784	85	63	2,259 50	1,102 50

CITY OR TOWN.	Neat Cattle Assessed.	Number Tested.	Number Paid for.	Amount Paid.	State Tax.
Webster, ...	262	3	-	-	$2,695 00
Wellesley, ...	289	6	6	$209 50	4,655 00
Wellfleet, ...	98	-	-	-	542 50
Wendell, ...	188	-	-	-	175 00
Wenham, ...	398	1	-	-	472 50
West Boylston, . .	682	5	4	131 00	962 50
West Bridgewater, .	759	47	21	917 50	700 00
West Brookfield, . .	1,025	41	28	718 50	595 00
West Newbury, . .	852	24	7	239 00	700 00
West Springfield, .	695	27	12	392 50	2,887 50
West Stockbridge, .	605	7	1	15 00	402 50
West Tisbury, . .	230	-	-	-	280 00
Westborough, . .	1,222	133	71	2,227 00	1,960 00
Westfield, ...	1,135	6	-	-	5,547 50
Westford, ...	809	44	39	1,209 30	962 50
Westhampton, . .	524	6	-	-	175 00
Westminster, . .	666	64	32	1,018 50	542 50
Weston, ...	914	102	95	3,243 50	2,502 50
Westport, ...	1,167	85	52	1,557 00	1,102 50
Westwood, ...	591	9	6	146 00	-
Weymouth, ...	529	2	-	-	4,777 50
Whately, ...	730	25	16	433 00	332 50
Whitman, ...	302	15	4	107 00	2,555 00
Wilbraham, ...	709	12	4	155 00	595 00
Williamsburg, . .	693	88	2	42 00	665 00
Williamstown, . .	1,380	-	-	-	1,767 50
Wilmington, . .	240	28	19	479 35	630 00
Winchendon, . .	476	10	5	121 00	1,545 00
Winchester, . . .	176	-	-	-	4,532 50
Windsor, ...	752	14	2	57 00	140 00
Winthrop, ...	302	3	-	-	3,045 00
Woburn, ...	336	23	15	487 00	6,795 00
Worcester, ...	1,888	126	75	2,648 49	63,507 50
Worthington, . .	914	41	6	177 50	227 50
Wrentham, ...	483	24	18	654 50	1,067 50
Yarmouth, ...	140	-	-	-	1,470 00
Total, . . .	210,801	9,991	5,435*	$185,448 56*	$1,750,000 00

The foregoing table does not include 254 animals which have been condemned, and warrants for which are now in the process of settlement. The estimated amount due for condemned cattle not paid for, and other outstanding bills, amount to $10,712.40.

The financial statement is as follows: —

Number cattle paid for as tuberculous, 5,275; amount paid,	$179,867 52
Number cattle paid for, no lesions found, 160; amount paid,	5,581 04
Quarantine expenses; amount paid, ...	2,928 11
Arbitration, amount paid, ...	27 75
Killing and burial expenses, amount paid, ...	125 93
Average per head for 5,435 cattle, $34.12; total amount paid,	$188,530 35
Amount carried forward, ...	$188,530 35

* These figures include 185 animals paid for in 1897 but quarantined and condemned in 1896.

Amount brought forward,		$188,530 35
Amount paid for commissioners' salaries,	$7,283 00	
Amount paid for agents' salaries,	13,561 54	
Amount paid for clerks' and stenographers' salaries,	5,201 04	
Expenses of commissioners,	3,781 80	
Expenses of agents,	11,869 28	
Expenses of office,	3,154 56	
Expenses of laboratory and experimental work,	1,515 17	
Expenses of implements,	1,883 75	
Expenses of quarantine stations,	3,870 35	
Expenses of glanders (killing and burial),	87 00	
		52,207 49
Total payments,		$240,737 84

During the year the average price per head has been	$34 12
For the first six months the average price per head has been	35 22
For the last six months the average price per head has been	30 45
For the last three months the average price per head has been	28 26
For the last one month the average price per head has been	29 69

The high average for the first six months and for the year is due in a great measure to the number of private tests that were made during the early months of the year.

Cash received during the year and turned over to the State Treasurer: —

For hides and carcasses,	$5,039 74
For sale of laboratory supplies,	76 09
For sale of pasture tags,	100 41
For use of telephone,	1 05
Total,	$5,217 29

In the work of inspecting the cattle in their respective towns the inspectors are supposed to make a physical examination of each animal on the premises. Any that they have reason to suspect as being diseased are placed in quarantine, to be examined later by the Cattle Commission, and either released or condemned, as may be decided. This work has gradually resulted in the advanced generalized cases of tuberculosis being picked out by the inspectors and destroyed,

until finally, as will be seen by an examination of the reports of the autopsies on the cattle killed, the cases of generalized or advanced cases of tuberculosis have become very scarce.

In the following tables the cases of advanced generalized tuberculosis among the cattle killed in 1897, excluding private test work, are compared with the reports for the years 1895 and 1896: —

Jan. 1 to Dec. 31, 1895.

Number of animals tested,	4,484.
Number of animals condemned and found diseased,	2,398, or 53.4 per cent.
General tuberculosis,	784, or 32.6 per cent.

Jan. 1 to Dec. 31, 1896.

Number of animals tested,	7,062.
Number of animals condemned and found diseased,	4,173, or 59.0 per cent.
General tuberculosis,	1,051, or 25.1 per cent.

Jan. 1 to Dec. 23, 1897.

Total number of animals tested to Dec. 23, 1897,	9,844.
Total number of animals condemned to Dec. 23, 1897,	5,062, or 51.43 per cent.
General tuberculosis to Dec. 23, 1897,	183, or 3.61 per cent.

It will be seen that these cases of advanced generalized tuberculosis have become very scarce, and these figures illustrate well the practical benefits resulting from this work.

In isolated cases or in out-of-the-way places the post-mortem examinations are often made by local inspectors. It is not unusual that they have had but little special training in this work, and their opinion as to whether the disease is generalized or not is not always reliable. As a check, therefore, on their averages, the following table was prepared from those cases where the autopsies were made at Brighton, or by reliable veterinarians; and it will be noticed that,

while the percentage is higher, yet it is close enough to confirm the averages for the year: —

Jan. 1 to Dec. 23, 1897.

Number of animals condemned and found diseased, the autopsies being made at Brighton or by reliable veterinarians, ...	3,590.
General tuberculosis, ...	177, or 4.37 per cent.

The law further provides, in section 29, chapter 491 of the Acts of 1894, that "Every person, except the members of the Board of Cattle Commissioners, who has knowledge of, or has good reason to suspect the existence of, any contagious disease among any species of domestic animal within the limits of this Commonwealth, or that any domestic animal is affected with any such contagious disease, whether such knowledge is obtained by personal examination or otherwise, shall immediately give written notice thereof to the board of health of the city or town where such diseased animal or animals are kept."

During the early part of this year this section of the law had an important bearing on the work of the Board; for, immediately on the granting of the appropriation for the continuance of the work, the Board began to be deluged with quarantine papers and letters from veterinarians and others, reporting cattle that had reacted to the tuberculin test applied by veterinarians in private practice.

Under the law, the only thing to be done was either to accept the veterinarian's test or to retest the herd; this latter was often found to be unsatisfactory, because of the frequent failure of animals to react to a second test. The result was that to a large extent the control of the appropriation was taken out of the hands of the Board; the money could not be placed where, in the opinion of the Board, it would do the most good, and they further realized that they had no guarantee from the owners that an honest effort would be made by these owners to get rid of the disease.

In doing voluntary request work and in testing entire herds the Board had always insisted that the owner should

agree to observe the sanitary requirements prescribed by them, introduce none but tested animals into the herd without first having them tested with tuberculin, and thoroughly disinfect the premises. These precautions were considered necessary, because it was thought to be of little use to test an entire herd and kill those that reacted, in the expectation of freeing the herd of disease, if untested or diseased animals were to take the place of those condemned, or if tested animals were to be put into infected stalls or stalls that had not been properly disinfected. This matter had evidently not been thoroughly explained to many of the parties that had their herds tested by private veterinarians; and so, because of this, the following letter was sent to all whose herds had been tested in this manner: —

COMMONWEALTH OF MASSACHUSETTS.

BOARD OF CATTLE COMMISSIONERS,
COMMONWEALTH BUILDING, BOSTON, April, 1897.

DEAR SIR: — We desire to call the attention of owners of cattle, whose herds have been tested by private test, to section 45, chapter 491 of 1894, as amended by section 10, chapter 496 of 1895. This section provides for the killing of animals found to be affected with any contagious disease. It further provides that, "whenever any cattle condemned as afflicted with the disease of tuberculosis are killed under the provision of this section, the full value thereof at the time of condemnation, not exceeding the sum of sixty dollars for any one animal, shall be paid to the owner thereof out of the treasury of the Commonwealth, if such animal has been owned within the State six months continuously prior to its being killed; *provided*, such person shall not have, prior thereto, *in the judgment of the Cattle Commissioners, by wilful act or neglect, contributed to the spread of tuberculosis;* but such decision on the part of the commissioners shall not deprive the owner of the right to arbitrate, as hereinafter provided."

If an owner does not thoroughly cleanse and disinfect his barn, or if, after having had his herd tested and paid for by the State, he introduces untested animals into his herd, he has through his neglect contributed to the spread of tuberculosis in his herd, and, therefore, under this section forfeits his right to compensation for such tuberculous animals as may hereafter be found in his herd. The commissioners desire to call your attention to this matter, so that you may fully understand their position in regard to it.

You are hereby requested to notify the Board what steps you take toward disinfecting your barn, and the date that the work was completed. Please pay particular attention to this last request.

Yours truly,

AUSTIN PETERS, *Chairman.*
JOHN M. PARKER, *Secretary.*
LEANDER F. HERRICK.
MAURICE O'CONNELL.
C. A. DENNEN.

This was not thought to be sufficient, however, and on the 12th of April an agent was appointed to visit these owners and report on the condition of the barns. In the mean time, because of the amount of private testing that was being done, the Legislature took the matter up, and a committee was appointed to investigate the condition of the cows condemned in certain herds in the neighborhood of Dracut and Lowell. This committee made a special report to the Legislature on the matter; in their report the majority of the committee recommended that "all testing of cattle with tuberculin, when compensation is expected, be limited to the Cattle Commissioners or their authorized agents. The Board of Cattle Commissioners have already expended more than $160,000 of the total appropriation of $250,000 made earlier in the session. If they are compelled to kill all reacting animals and allow full compensation for the diseased cattle, the remainder of the appropriation will soon be exhausted. There will then be no money for the prosecution of the regular work of the commission, or the slaughter of those animals reported by the local inspectors as suspicious cases, and which are really the most dangerous animals to the health and comfort of the general public. The commissioners are not allowed to exceed their appropriation, hence all their work must stop when their money gives out."

As a result of this recommendation, the following law was passed and approved June 10, 1897: —

[CHAPTER 499 OF THE ACTS OF 1897.]

SECTION 1. No person having animals tested with tuberculin shall be entitled to compensation from the treasury of the Commonwealth for any animals that react to the tuberculin test, unless

such testing be done by the State Board of Cattle Commissioners, or their authorized agents acting as such at the time of the test, and such testing shall be subject to the supervision and control of the State Board of Cattle Commissioners.

SECT. 2. This act shall take effect upon its passage.

The names of the towns, the number of cattle in each herd and the value and numbers of those condemned previous to the passage of this act are as follows: —

Private Tests reported by Dr. W. E. Peterson.

OWNER.	Town.	Number Tested.	Number Condemned.	Amount.	Per Cent. of Disease.
C. Warren,	Waltham,	38	2	$65 00	5.26
P. Brodrick,	"	28	14	553 00	50.00
C. Viles,	"	37	34	1,298 00	81.89
School for Feeble-minded Children.	"	17	1	35 00	5.88
L. H. Bent,	Sudbury,	30	18	799 00	60.00
W. L. Stone & Son,	"	28	25	1,161 00	89.28
C. L. Noyes,	"	21	3	101 00	14.28
J. Quinn,	"	14	8	270 00	57.14
J. Rafuse,	"	18	14	547 00	77.77
G. A. Haynes,	"	56	13	574 00	23.21
F. Haynes,	"	17	5	197 00	29.41
H. M. Noyes,	"	19	16	637 00	84.21
F. W. Buttrick,	"	2	1	20 00	50.00
F. E. Bent,	"	6	3	123 68	50.00
G. Gilman,	"	5	2	92 00	40.00
F. Rouse,	"	13	6	218 00	46.15
G. Haynes,	"	11	4	104 00	36.36
J. Clark,	"	2	1	30 00	50.00
A. F. Hunt,	"	9	6	235 00	66.66
A. M. Thompson,	"	17	7	307 00	41.17
J. E. Bent,	"	16	12	565 00	75.00
Town Farm,	"	19	6	214 00	31.57
J. Austin,	"	17	12	513 00	70.58
F. P. Barton,	"	15	13	437 00	86.66
P. Maguire,	"	20	5	184 00	25.00
M. J. Haynes,	"	26	22	678 00	84.61
L. F. Flood,	"	18	12	566 00	66.66
J. Dwyer,	"	14	13	592 00	91.42
F. M. Bowker,	"	14	10	370 00	71.42
J. S. Rice,	"	11	7	305 50	63.63
A. Dakin,	"	10	-	-	-
R. W. Powers,	"	16	7	275 00	43.75
P. Pilkington,	"	14	9	331 00	64.28
C. E. Haynes,	"	14	4	149 00	28.57
L. P. Bent,	"	11	6	230 00	54.54
H. C. Bowers,	"	2	2	90 00	100.00
Goodnow Bros.,	"	11	7	252 00	63.63
E. McManus,	"	6	5	231 00	83.22
G. L. Goodnow,	"	6	-	-	-
E. Goodnow,	"	13	7	373 00	58.84
S. D. Perry,	"	23	22	1,039 00	95.65
T. F. O'Neil,	"	14	4	191 00	28.57
E. Senett,	"	4	1	35 00	25.00
C. W. Rice,	"	28	12	457 00	42.85
J. E. Bent,	Maynard,	9	1	40 00	11.11
S. G. Brown,	"	8	7	289 00	87.05
D. Mynahan,	"	15	2	92 50	13.33

OWNER.	Town.	Number Tested.	Number Condemned.	Amount.	Per Cent. of Disease.
J. H. Sullivan,	Maynard,	23	14	$595 00	60.86
H B. Fowler,	"	20	9	367 00	45.00
G. F. Brown,	"	1	1	32 00	100.00
J. F. Parmenter,	"	23	19	784 00	82.06
W. F. Litchfield,	"	3	1	38 00	33.33
C. Brooks,	"	5	5	220 00	100.00
J. A. Johnson,	"	6	6	225 00	100.00
J. H. Vose,	"	12	6	218 00	50.00
E. B. Wilcomb,	"	11	7	218 00	33.33
C. A. Whitney,	"	15	7	248 00	46.66
G. E. Whitney,	"	14	6	220 00	42.84
G. A. Whitney,	"	1	1	32 00	100.00
L. C. Colbert,	"	6	2	75 00	33.33
C. Randall,	"	5	4	170 00	80.00
W. Parmenter,	"	10	1	40 00	10.00
M. W. Hynes,	Wayland,	10	3	140 00	30.00
T. L. Hynes,	"	4	2	85 00	50.00
H. Walker,	"	14	1	40 00	7.14
G Patterson,	Stow,	16	5	178 00	31.25
H. S. Hapgood,	"	20	14	429 00	70.00
W. H. Lord,	"	12	10	360 00	83.33
B. C. Brown,	"	3	-	-	-
G. W. Bradley,	"	4	3	102 00	75.00
Benj Clark,	"	8	6	238 00	75.00
A. W. Puffer,	"	4	4	172 00	100.00
A. Tuttle,	"	8	8	263 50	100.00
F. W. Hapgood,	"	2	1	52 00	40.00
W. Toohey,	"	5	2	65 00	-
P. A. Gately,	"	5	-	-	-
J. J. Gately,	"	13	3	108 00	23.07
J. Lund,	"	1	-	-	-
F. Bond,	"	6	-	-	-
J. Johnson,	"	6	2	77 00	33.33
W. C. Robbins,	Acton,	50	33	1,375 00	66.00
C. B. Robbins,	"	24	21	721 00	87.05
A. Cole,	"	18	11	491 00	61.11
J. K. W. Wetherbee,	"	10	8	306 00	80.00
H. D. Clark,	Weston,	13	11	499 00	84.61
F. B Ripley,	"	10	8	324 00	80.00
L. E. Roberts,	"	18	14	444 00	77.77
G. B. Milton,	"	7	2	63 00	28.56
C. H. Bryden,	"	18	17	620 00	94.44
H. Zoller,	"	42	23	670 00	54.76
A. G. Loker,	"	18	11	364 00	61.11
M. L. Currant,	Lexington,	29	17	746 00	58.60
S. M. Lawrence,	"	35	31	1,249 00	88.57
E. T. Payson,	"	2	2	70 00	100.00
H. E. Barnes,	Lincoln,	15	8	390 00	53.33
R. Sherman,	"	12	1	32 50	8.33
L. Mayer,	"	18	18	881 00	100.00
D. H. Sherman,	"	32	8	347 00	25.00
H. J. Harrington,	"	11	4	157 00	36.36
J. Thompson,	"	8	8	268 00	100.00
G. Miles,	Concord,	23	23	787 00	100.00
C. H. Bryan,	"	7	6	243 00	85.71
J. A. Hager,	Marlborough,	24	12	557 00	50.00

Private Tests reported by Dr. A. J. Sheldon.

R. Fox,	Dracut,	41	30	$1,245 00	73.17
D. S. Fox,	"	10	8	300 00	80.00
C. E. Jones,	"	15	10	372 00	66.66
F. A. Fox,	"	51	48	1,567 68	94.11
E. T. Fox,	"	17	8	384 80	47.05

OWNER.	Town.	Number Tested.	Number Condemned.	Amount.	Per Cent. of Disease.
A. J. Thissell,	Dracut,	10	7	$296 52	70.00
O. Merrill,	"	14	2	75 00	14.28
Thompson Island Farm School.	Boston,	33	28	1,280 00	84.84
		26	15	685 00	57.69
D. M. Davis,	Newburyport,	9	2	55 00	22.22
G. A. Minot,	"	2	2	62 00	100.00
G. Dokum,	"	10	1	38 00	10.00
J. M. Chase,	"	11	3	95 00	27.27
W. H. Safford,	"	5	2	90 50	40.00
A. T. Newhall,	"	21	10	298 50	47.61
F. D. Moseley,	"	32	7	181 00	21.87
C. P. Bartlett,	"	20	14	529 50	70.00
J. Mahoney,	"	5	1	45 00	20.00
E. G. Moseley,	"	2	1	30 00	50.00
G. F. Penniman,	Chelmsford,	20	13	627 00	65.00
J. Plummer,	"	22	7	269 00	31.81
H. D. Pierce's estate,	Canton,	57	3	135 00	5.43
Town Farm,	Billerica,	18	13	558 00	66.66
J. N. Pardee,	"	5	2	70 00	40.00
W. Holden,	"	23	4	203 00	17.39
N. R. Jones,	"	23	15	667 00	65.22
A. Woodward,	"	3	3	165 00	100.00
G. E. Simons,	"	5	5	270 00	100.00
J. Sullivan,	"	6	6	191 88	100.00
B. Kerney,	"	5	4	215 00	80.00
D. Lane,	"	12	11	504 67	91.66
J. E. Rowell,	"	18	11	559 50	61.11
H. Dutton,	"	1	1	45 00	100.00
F. A. Patch,	Boxborough,	36	9	332 00	25.00
Geo. Mixter,	Hardwick,	68	1	15 00	1.48

Private Test reported by Dr. J. F. Winchester.

J. Plummer,	Chelmsford,	11	9	$408 00	81.81

Private Tests reported by Dr. M. Bunker.

T. L. Lane,	Wayland,	25	17	$577 50	68.00
J. T. Cowen,	"	10	7	222 50	70.00
F. S. Kimball,	Brighton,	-	-	-	-

Private Test reported by Dr. G. N. Kinnell.

Baker Bros.,	Lanesborough,	42	37	$1,217 00	88.08

Private Tests reported by Dr. C. S. Moore.

F. Kimball,	Danvers,	17	4	$170 00	23.53
B. W. Perry,	"	-	1	-	-
J. E Porter,	"	8	7	262 00	87.49
J. B. McCarthy,	"	12	5	265 00	41.66
O. F. Putnam,	"	-	1	35 00	-
J. M. Putnam,	"	8	3	70 00	27.49
J. Swinerton,	"	2	1	20 00	50.00

Private Test reported by Dr. J. H. Seale.

OWNER.	Town.	Number Tested.	Number Condemned.	Amount.	Per Cent. of Disease.
M. Thurlow, . . .	Amesbury, .	8	8	$262 00	100.00

Private Test reported by Dr. A. H. Streeter.

W. A. Harlow, . .	Cummington, .	18	9	$340 00	50.00

Private Test reported by Dr. A. L. Cundall.

J. D. Tyler, . . .	Berlin, . .	14	2	$52 50	14.28

Private Test reported by Dr. A. S. Cleaves.

E. W. Goddard, . .	Barre, . .	3	1	$30 00	33.33

Private Tests reported by Dr. C. A. Hamblet.

R. D. Coburn, . . .	Dracut, . .	-	1	$50 00	-
E. T. Fox, . . .	" . .	-	10	511 00	-
N. D. Peavey, . . .	" . .	4	3	125 00	75.00
F. R. Hill, . . .	" . .	-	2	87 50	-
G. Brown, . . .	" . .	-	1	47 50	-

Private Test reported by Dr. W. S. Eaton.

E. Mills, ...	Dracut, . .	5	4	$150 00	80.00

Private Tests reported by Dr. E. Knobel.

G. W. Wetherbee, . .	Dedham, .	2	2	$55 00	100.00
G. Reed, ...	" .	2	2	50 00	100.00

Private Test reported by Dr. J. H. Dutton.

J. P. Emerson, . .	Chelmsford, .	40	11	$405 00	27.05

Private Test reported by J. W. Robinson.

C. Whitemore, . . .	Natick, . .	28	18	$766 00	64.28

Private Test reported by Dr. S. O. Fowle.

OWNER.	Town.	Number Tested.	Number Condemned.	Amount.	Per Cent. of Disease.
A. R. Jones, . . .	Wellesley, .	-	1	$35 00	-

Private Tests reported by Dr. G. N. Kinnell (2d test).

OWNER.	Town.	Number Tested.	Number Condemned.	Amount.	Per Cent. of Disease.
J. Kirlhner, . . .	Dalton, . .	16	-	-	-
J. A. Bourgner, . .	" . .	18	-	-	-
G. Loehr, ...	" . .	13	-	-	-
W. Kirlhner, . . .	" . .	15	-	-	-
H. Finger, . . .	Lanesborough,	14	-	-	-
Thomas Brennan, . .	"	19	-	-	-
J. E. Lamb, . . .	"	8	-	-	-
Dow Bros., . . .	"	8	-	-	-
E. A. Wood, . . .	"	24	-	-	-
D. B. Dewy, . . .	Lenox, . .	25	-	-	-
F. E. Curtis, . . .	" . .	23	-	-	-
F. S. Clark, . . .	Richmond, .	18	-	-	-
F. Loehr, . . .	Washington, .	23	3	$125 00	13.04
J. Newbury, Jr., . .	" .	30	-	-	-
J. Eichelser, . . .	" .	22	-	-	-
P. Eichelser, . . .	" .	21	-	-	-

These figures are interesting, because they show relatively the amount of disease in a large number of herds. It will be noticed that the herds in the western part of the State show only a very small proportion of disease. These herds had previously been tested and cleaned up, this being the second test.

It would appear also that there are fewer cows in the western part of the State that react, and consequently the barns there are not so saturated with infectious material. These tests, however, have their value as tending to show on a large scale what proportion of the cattle in the State would react to the test. The proportional number of reacting animals would appear to be exaggerated, were it not for the fact that these figures are corroborated by other herds tested at various intervals by different parties, where the per cent. of disease appears to be about the same. The only conclusion that we can arrive at, then, is that the number of animals that react to the test is extremely large. Fortunately, by far the larger proportion of these cases have only slight localized tuberculosis, the majority of which might never develop.

While this testing was going on, and previous to the passage of the law relating to private testing of herds, the Board began to realize the necessity for the passage of some such law. It was evident that many of these owners had not realized what they were undertaking; it was evident that others had no intention of co-operating with the State in endeavoring to get rid of the disease, and certainly there was little use in attempting to help those who would not try to help themselves. Being written to and talked to seemed to have little effect; it was only when told that they were laying themselves liable to forfeit their right to compensation in the future that there was any perceptible improvement. (See letter to owners of herds tested by private test, page 25.)

In this connection, the report on the amount of cleansing and disinfection that has been done by these owners is instructive: —

	Filthy Stables.	Unclean Stables.	Clean but not Disinfected.	Satisfactory Stables.
First visit, . .	11	42	35	52
Second visit, . .	4	7	32	33
Third visit, . .	2	4	4	3

It will be noticed that, after being written to, in only 52 out of 140 barns first visited had the owners cleansed or disinfected their premises after the removal of diseased animals. On the second visit the showing was a little better, — 85 out of the 140 visited had been cleaned and were in a satisfactory condition; but it was not only in the case of those having had their herds tested by private test that disinfection was ordered. All barns from which cattle were taken, as tuberculous, were ordered disinfected, and inspectors were instructed to call the attention of owners to section 45, chapter 491, etc. : —

Inspectors will please call the attention of owners to section 45, chapter 491 of the Acts of 1894, as amended by section 10, chapter 496 of the Acts of 1895. This section makes provision for th

compensation of owners, provided "such person shall not have, prior thereto, in the judgment of the Cattle Commissioners, by wilful act or neglect contributed to the spread of tuberculosis." If after suitable notice an owner introduces diseased animals into his herd, or fails to thoroughly disinfect his premises, he contributes to the spread of tuberculosis by neglecting to take reasonable precaution against the spread of the disease, and lays himself liable to forfeit his right to compensation.

The regulations issued by the Board bearing on this subject are as follows: —

Regulations of Massachusetts Board of Cattle Commissioners for cleansing and disinfecting Barns.

[These must be complied with by owners of cattle which the State pays for.]

In attempting to get rid of tuberculosis in a herd of cattle, it should be remembered that not only is it necessary that all the diseased animals be picked out and either isolated or destroyed, but that no new animals should be introduced unless they have been tested and are known to be free from disease.

The barns should also undergo a thorough renovation, and be properly cleansed and disinfected before they are again occupied.

In renovating or remodelling barns, the great importance of sunlight, thorough ventilation and good drainage should always be borne in mind.

Disinfection of the barns is always necessary to destroy any infectious material that may have been left after the removal of diseased cattle. The best disinfectant we know is sunlight. Germs of disease will live but a short time when exposed to the direct rays of the sun; and for this reason, if for no other, a southerly exposure and plenty of windows in the barn are to be desired.

In proceeding to disinfect a barn, the first and perhaps the most important step to be taken is to collect all rubbish, have the walls, ceilings and floors thoroughly swept and cleansed of all litter, dust, cobwebs and the like. The floors, mangers, feeding troughs and stanchions should be carefully scraped and cleaned, special care being taken with the corners, and all of the rubbish collected and burned.

All odds and ends of boards and old broken mangers and partitions should also be removed and burned, and, when occasion requires it, new plank floors should be laid in place of old ones.

After cleansing thoroughly with hoe and broom, and hose if running water is convenient, and, if the barn contains a boiler, with scalding water or live steam, applied with a hose, or, failing

that, with boiling water and soft soap or washing soda, a solution of bichloride of mercury (corrosive sublimate), 1 to 1,000 parts of water, should be applied with a whitewash brush and poured over the floors (corrosive sublimate should be used in wooden vessels, as it corrodes metal ones).

After applying the corrosive sublimate, the ceilings, walls, partitions, mangers, etc., should again be washed and gone over with warm, freshly made whitewash; a half pound of chloride of lime to the gallon of whitewash is an addition that may make it more effective. Fumigating with sulphur or chloride gas is not of any great value in ordinary stables.

In using corrosive sublimate, it must be borne in mind that it is a dangerous poison, and mangers and partitions should be carefully washed after applying this mixture, and then again scalded or whitewashed.

If at a season of the year when the animals can be turned out, the stables should be left vacant for some time, with doors and windows open.

Six months after the first test the herd should again be tested and undergo a careful physical examination, so as to be certain that no diseased animals have been overlooked, and the barns should again be thoroughly disinfected.

Great care should also be taken that all animals have been tested before their introduction to the herd.

It would appear, from the report of the inspector, that this work needed to be looked after. It will be noticed that, out of over 700 barns visited, only 59 had been cleansed and disinfected satisfactorily at the first visit; on the second visit the figures were reversed, and instead of 397 filthy barns there were only 43. The work is summed up as follows: —

	Filthy Stables.	Unclean Stables.	Clean but not Disinfected.	Satisfactory Stables.
First visit, . .	397	141	120	59
Second visit, . .	43	37	211	234
Third visit, . .	3	11	106	26

The general law under which the inspectors are appointed further provides, under section 20, chapter 491 of the Acts of 1894, as amended by section 6 of chapter 496 of the Acts of 1895, that "inspectors must be present at all

licensed slaughter houses or establishments upon the day or days designated for slaughter, and there carefully examine at the time of slaughter the carcasses of any and all neat cattle, sheep and swine slaughtered thereat. And it shall be the duty of such inspectors also to examine at the time of slaughter any and all neat cattle, sheep and swine when owned by any person not engaged in such business, and when the same are slaughtered upon his own premises other than a slaughter house, etc., unless the said animal is less than six months old, or has been inspected within six months prior to such slaughter, and a certificate of health has been delivered to the owner or person in charge."

Under section 5, chapter 491 of the Acts of 1894, every inspector shall keep a record of all inspections and his doings thereon, and shall make regular returns of all such inspections to the Board of Cattle Commissioners. Under this provision the inspectors have reported the following work: —

Number of cattle inspected at time of slaughter, under section 21,	975
Number of sheep inspected at time of slaughter, under section 21,	157
Number of swine inspected at time of slaughter, under section 21,	3,345
Number of cattle inspected at licensed slaughter houses at time of slaughter,	187,416
Number of sheep inspected at licensed slaughter houses at time of slaughter,	405,201
Number of swine inspected at licensed slaughter houses at time of slaughter,	1,468,334
Total number of animals inspected at time of slaughter, including those inspected at licensed slaughter houses, and also under section 21,	2,065,428
Cattle destroyed as tuberculous,	302
Sheep destroyed as tuberculous,	*2
Swine destroyed as tuberculous,	105
Percentage of cattle found infected,	.16
Percentage of sheep found infected,	–
Percentage of swine found infected,	.0071
Number of towns with licensed slaughter houses,	102
Number of licensed slaughter houses,	228

* These were probably not tuberculous, but were cases of Œsophagostoma Columbianum, which was very likely mistaken for tuberculosis by the local inspector.

The second division of the work — the examination of all cattle coming into the markets at Brighton, Watertown and Somerville from without the State for sale, — is an exceedingly important one. Its object of course is to provide a market where those desiring to secure tested cows can do so. This is important, and would be valuable if it were possible to rely on these tests as correct; unfortunately, there is frequently good reason for doubting the reliability of many of them.

During the year from Dec. 15, 1896, to Dec. 15, 1897, the number of cattle received at Brighton has been as follows: —

Maine cattle,	12,040
New Hampshire cattle,	1,890
New York cattle,	689
Massachusetts cattle,	9,964
Western cattle,	14,719
Sheep,	55,260
Swine,	639,374
Veals,	28,878
Horses,	4,060
Cattle released by certificate,	10,540
Cattle tested,	171
Cattle released after test,	141
Cattle released for slaughter,	9
Cattle condemned,	21

Watertown, Dec. 15, 1896, to Dec. 15, 1897.

Vermont cattle,	6,609
New Hampshire cattle,	8,144
New York cattle,	274
Massachusetts cattle,	933
Western cattle,	171,562
Sheep,	514,608
Swine,	766,920
Veals,	63,927
Horses,	24,762
Cattle released by certificate,	8,240
Cattle released by pasture tags,	99
Cattle tested,	42
Cattle released after test,	34
Cattle released for slaughter,	1
Cattle condemned,	7

Somerville, Dec. 15, 1896, to Dec. 15, 1897.

Western cattle,	114,562
New England cattle (Vermont and New Hampshire),	4,421
Massachusetts cattle,	1,082
Sheep,	367,202
Calves,	46,262
Hogs,	13,172
Cattle released on certificates,	688
Cattle tested and released,	14
Cattle condemned, actinomycosis,	2

Recapitulation.

Total number cattle for beef,	346,889
Total number sheep,	937,070
Total number hogs,	1,419,466
Total number calves,	139,067
Total number horses,	28,822
Total number released on certificates,	19,468
Total number tested at stations,	227
Total number released at stations,	199
Total number condemned at stations,	28
Total number condemned for actinomycosis,	2

In all from Dec. 15, 1896, to Dec. 15, 1897, 346,889 cattle have passed through Brighton, Watertown and Somerville from outside the State. During the same period of time, from Dec. 15, 1896, to Dec. 15, 1897, 7,068 cattle have been admitted to the State on special permit.

This division of the work, the examination and identification of cattle coming in from without the State upon special permit, also deals with the admission of out-of-State cattle; and it has been found that the difficulties and disadvantages to be met with at the Brighton, Watertown and Somerville markets are to be met with in this department of the work as well. It is expected, of course, that these cattle are tested either before or after arrival.

The table following shows the number of cattle brought in month by month on special permit, making in all 7,068 cattle brought in on 492 permits: —

From Dec. 15, 1895, to Dec. 31, 1896,	421
January, 1897,	333
February, 1897,	261
March, 1897,	462
April, 1897,	289
May, 1897,	198
June, 1897,	315
July, 1897,	325
August, 1897,	703
September, 1897,	857
October, 1897,	1,374
November, 1897,	1,187
December, 1897,	343
Total,	7,068

The question of the advisability of placing quarantine restrictions on cattle coming into a country or State is one that is thoroughly well established. In Europe quarantine regulations and the requirement of the tuberculin test is very general. On this continent both the United States and Canadian governments require it, and it is also required by several of the different States before cattle are permitted to pass their borders. Unfortunately, the difficulties in its enforcement are great. The alternative consists in the Board appointing their own agents to do the testing in the various States from which the cattle are generally shipped. Consequently, at a meeting of the Board, held October 2, it was decided that the Board should appoint their own agents to do the testing on cattle coming in from without the State; and in pursuance with this decision the following letters were prepared, and will be issued as soon as the list of out-of-State agents is completed: —

Letter to Agents.

BOSTON, Jan. 1, 1898.

DEAR SIR: — The Massachusetts Board of Cattle Commissioners is of the opinion that, in order to protect the cattle owners of Massachusetts from bovine tuberculosis to the greatest practicable extent, the work of testing cattle outside the State, to be brought into Massachusetts, should be done in the most careful and efficient manner possible.

In order to perfect this branch of our work as far as we are able, it has been decided to consider those testing cattle with tuberculin, for farmers and dealers, to be brought into this State,

as our agents outside of this Commonwealth, and this Board will only accept the tests of such men as we approve of.

All tests are to be made at the expense of the owners or buyers, and not at that of the Massachusetts Cattle Commission.

Each tested animal must have an ear-tag, furnished by this Board at cost; the number on the ear-tag must correspond with the number on the certificate; and the appearance of the animal must also agree with the description of the certificate, otherwise the certificate will be considered valueless.

You have been approved of by the Massachusetts Board of Cattle Commissioners to test neat cattle to be shipped to Massachusetts, and we will continue to accept your tests as long as we are of the opinion that they are being made in a careful and conscientious manner; if at any time, however, we have reason to be dissatisfied with your work, we retain the privilege of summarily dropping your name from our list.

We also request you to keep us informed as to the source of the tuberculin you use, the strength of the solution and size of dose, all of which must meet with our approval.

Per order,

MASSACHUSETTS BOARD CATTLE COMMISSIONERS.

Letter to Dealers.

BOSTON, Jan. 1, 1898.

DEAR SIR: — The Massachusetts Board of Cattle Commissioners is of the opinion that, in order to protect the cattle owners of Massachusetts from bovine tuberculosis to the greatest practicable extent, the work of testing cattle outside of this State, to be brought in here, should be done in the most careful and efficient manner possible.

In order to perfect this branch of our work as far as we are able, it has been decided to consider those testing cattle with tuberculin, for dealers and farmers, to be brought into Massachusetts, as our agents outside of this Commonwealth, and this Board will only accept the tests of such men as we approve of.

A printed list of the men we consider reliable will be furnished on application. This list may be revised from time to time, as new applicants may be added or men who prove either dishonest or incompetent are dropped from it.

All tests are to be made at the expense of the owners or buyers of the animals, and not at that of the Massachusetts Cattle Commission.

All neat cattle over six months old brought into the State purporting to have been tested will be quarantined and tested, unless

such test has been made by an authorized out-of-the-State agent of the Massachusetts Board of Cattle Commissioners.

Each tested animal must have an ear-tag, furnished by this Board at cost; the number of the ear-tag must correspond with the number on the certificate; and the description on the certificate must also agree with the appearance of the animal, otherwise the certificate will be considered valueless.

Per order,

MASSACHUSETTS BOARD CATTLE COMMISSIONERS.

The fourth division of the work, the conduct of laboratory and stable experiments to determine problems connected with the work of the Board, has been fruitful of results. Under this head may be classed the retesting of certain herds that had previously been tested by the Board. This work illustrates well the difficulty that sometimes exists in freeing a herd from tuberculosis. The work has been tabulated, and shows that in some cases the herds have been tested several times, yet, although possibly to a less extent, the disease still exists in many of these herds.

	1894.			1895.			1896.			1897.		
	Number Tested.	Number Condemned.	Per Cent.	Number Tested.	Number Condemned.	Per Cent.	Number Tested.	Number Condemned.	Per Cent.	Number Tested.	Number Condemned.	Per Cent.
Henry Heywood, Gardner,	-	-	-	81	30	37.03	50	27	54.00	100	31	31.00
	-	-	-	-	-	-	-	-	-	106	12	11.32
P. M. Harwood, Barre,	-	-	-	27	20	74.07	9	1	11.11	-	-	-
T. P. and C. S. Root, Barre,	-	-	-	36	3	8.33	29	5	17.24	-	-	-
G. L. Clemence, Southbridge.	-	-	-	26	5	19.23	34	5	14.70	-	-	-
F. B. Bridgeman, Westhampton.	-	-	-	11	5	45.45	22	5	17.85	-	-	-
Baker Brothers, Lanesborough.	-	-	-	-	-	-	42	37	88.09	21	-	-
Geo. H. Ellis, West Newton.	69	29	42.02	-	-	-	79	13	16.04	134	23	17.16
	-	-	-	-	-	-	68	2	2.09	148	6	4.05
Geo. H. Ellis, Concord,	-	-	-	-	-	-	64	6	9.37	38	1	2.62
	-	-	-	-	-	-	-	-	-	62	4	6.45
Geo. H. Ellis, Kendal Green.	-	-	-	-	-	-	74	20	27.02	49	5	10.20
	-	-	-	-	-	-	-	-	-	50	-	-
F. B. Page, Gardner,	-	-	-	28	3	10.70	-	-	-	30	3	10.00
J. Eichelser, Washington,	-	-	-	18	2	11.11	-	-	-	22	-	-
Farm School, Thompson Island.	-	-	-	28	3	10.71	-	-	-	26	15	57.69
	-	-	-	-	-	-	-	-	-	30	-	-

NOTE. — The difference in these figures between the number of animals tested on the first and later tests is accounted for by the purchase of new animals that *had been tested* or by the natural increase in the herd.

In the case of Mr. Ellis's herd an endeavor was made to locate the source of reinfection, and the diseased portions of six of the last cows were submitted to Prof. Theobold Smith, to get an opinion as to the age of the lesions. His opinion on this point was a singularly strong confirmation of the opinion that the cattle contracted the disease after their introduction to the barn. These cows were tested and appeared all right before being bought. They reacted after three months had elapsed; on autopsy the lesions were found to be slight, and on examination by Professor Smith he stated that in his opinion they were only from two to three months old. This would seem to indicate that the disease was probably contracted in the barn, and corroborates the opinion held by the Board of the danger to cattle recently introduced into infected barns. This danger exists to a greater or less extent in all barns that have been inhabited by diseased cattle.

Another idea that naturally suggests itself is that it might be well to advise every farmer or owner in the State to cleanse and whitewash his barn say twice a year, whether any cattle have been taken out or not; in this way, if any infectious material existed in the barn it would at least be reduced in quantity, the danger would be lessened, and of course if this disinfection was kept up it would materially lessen the amount of infectious material, and therefore lessen the danger to the other cattle in the barn. On the other hand, if neither diseased cattle nor infectious material had been in the barn, it would at least do no harm to wash and whitewash, and it would tend to inculcate ideas of cleanliness where perhaps they had been wanting.

During the year, on the request of several owners, and on their promising to observe certain conditions, a number of animals that had reacted to the test were kept in quarantine in separate buildings for observation and experimental purposes.

In the month of December, 1894, a bull belonging to G. H. Ellis of Newton was tested, with the following reaction: —

Dec. 28, 1894 — 7.30 A.M., 101; 5 A.M., 99.4; 7 A.M., 101.1; 9 A.M., 101; 12 M., 101.1; 3 P.M., 103.1; 5 P.M., 102.3.

It has since been tested six times, showing the following reactions: —

March 18, 1896 — 8 P.M., 101; 6 A.M., 101, 101.2, 103.4, 104.4, 104.3, 104.2, 104.3, 104.2, 103.
June 13, 1896 — 9.30 P.M., 101.1; 7.30 A.M., 102.3, 103.1, 103.1, 103, 103, 103, 101.3.
June 20, 1896 — 9.30 P.M., 101; 6.30 A.M., 101.2, 101.3, 101.2, 101.2, 101.3.
Aug. 18, 1896 — 7 P.M., 101.2; 5 A.M., 101.1, 101, 102.2, 103.4, 104, 103.4, 103.4.
Aug. 18, 1897 — 8 P.M., 101, 101.1; 7 A.M., 101.2, 103.1, 104.3, 105.
December, 1897 — 6 P.M., 101; 4 A.M., 100.3, 100.3, 100.2; 100.1, 100.

It will be noticed that the bull was tested June 13, and again on June 20. At the second test there was no reaction; this is a characteristic of tuberculin, as frequently there is no reaction at a second test until a considerable time has elapsed.

On the last test, in December, 1897, there was again no reaction; but whether this was due to an insusceptibility to the test or to the cure of the disease, it is impossible to say at the present time.

In the month of February, 1897, the Board received notice from Dr. Kinnell of Pittsfield that he had tested a herd of Siementhal cattle, consisting of four cows and a bull, two of which had reacted to the test. These tests were accompanied by a letter from Dr. Kinnell, which is as follows: —

WILLIAM DOUGLAS SLOANE, Esq., *Lenox.*

Four Cows and a Bull tested Feb. 11 and 12, 1897. — Breed, "Siementhal" Cattle.

Numbers on Horns.	10 P.M.	8 A.M.	10 A.M.	12 M.	2 P.M.	REMARKS.
635	101	101.2	100.2	100.6	101.4	- -
414	100.8	103	105	108	107	- -
76	101	102.6	102.2	101.4	101.4	Heavy in calf.
71	101	102.4	102.8	102.4	102	Aborted four weeks ago.
Bull.	101.6	106	107	106.6	105.4	- -

No. 414 had a chill, commencing twelve hours after injection and continuing four hours. She was noticed to cough during the chill. Bull had a chill, commencing at eighth hour after injection and lasting six hours.

Dr. PARKER, *Secretary Massachusetts Cattle Commission.*

DEAR SIR: — These animals were imported from Belgium about six months ago. They were kept in quarantine for three months, Garfield, N. J., and brought here on a permit from your office last September (1896). They were at once put in quarantine by Inspector Flint of Lenox, and have been so kept ever since.

In regard to Nos. 635, 76 and 71, I would say that I consider them free from tuberculosis. Nos. 76 and 71 gave slight reactions, but, from the fact that they showed no constitutional symptoms, and from the fact that No. 414 and the bull gave such decided reactions, I should think that the slight reaction was due to the peculiar conditions under which they have been kept, and perhaps also due to their breeding. In addition to these, one of them aborted comparatively recently, and the other is heavy in calf.

The owner of these animals purchased and brought them to this country at very great expense, and, apart from that, is most anxious to establish a herd of this breed. Consequently, I am commissioned to write to you and try if we cannot arrange to deal with them somewhat differently than with ordinary cases. Knowing that with proper care it is quite possible to breed sound stock by this bull and from the diseased cow, we would like it if you would allow this cow and bull to remain permanently in quarantine or until further orders, and not to slaughter them. Mr. Sloane is willing to give every assurance and guarantee that they will not be sold, or moved from the farm, or killed for beef, or brought into contact with other animals, except of course in the case of the bull being allowed to copulate with the cows.

I would say that Mr. Sloane fully appreciates the dangers of tuberculosis, and is fully in sympathy with all that is being done to eradicate it. Two years ago he cleaned up his herd of blooded Jerseys at great pecuniary loss, and would not now do anything that would in the least endanger the health of his herd; and any special features of quarantine which you might suggest or wish in regard to these animals would be rigidly carried out. But, if this is more than you as a State official can grant, would not the fact that they have been brought such a long journey and have been kept under such varied and trying conditions justify you in keeping them indefinitely in quarantine for retest?

Hoping that this may meet with the favorable consideration of your Board, I remain,

Truly yours, GEO. N. KINNELL.

P.S. Of course Mr. Sloane would agree to waive all claims for quarantine expenses, and would sterilize or destroy the products from the diseased cow, as you might direct. G. N. K.

On receipt of this letter from Dr. Kinnell, the owner was communicated with and the following answer received : —

642 Fifth Avenue, N. Y., Feb. 18, 1897.

John M. Parker, Esq., *Secretary*.

Dear Sir : — Your favor of the 16th has been forwarded to me from Lenox.

The few " Siementhal " cattle I possess form part of a herd imported last August, and were at the United States government quarantine station until end of November. The large portion of the herd are now in New York, and were inspected by the State veterinarian and given a clean bill. I cannot but think that in my case the reaction from test shown in two of my herd must be due to some climatic conditions, for tuberculosis is not known in the locality from which these cattle come. My main object in importing them was to cross them with my Jerseys. As latter breed seemed sensitive to the disease, I shall be glad to have Dr. Kinnell confer with my manager again ; latter will carry out whatever instructions he may receive. Yours truly, Wm. D. Sloane.

After a meeting of the Board, the owner and Dr. Kinnell were both communicated with. The letter to the owner was as follows : —

COMMONWEALTH OF MASSACHUSETTS.

Board of Cattle Commissioners, Boston, March 1, 1897.

Mr. W. D. Sloane, *642 Fifth Avenue, New York*.

Dear Sir : — As I promised you, I brought the matter referred to in my last letter to you before the meeting of the Board, held on February 22, and I am instructed to write you that the Board is willing that you should be allowed to keep the cattle and breed from them, providing that we have your guaranty that they will be kept separate from the rest of the herd, that the State will not be called upon to pay for quarantine expense, that no milk will be sold from the cow, and that the Board are kept informed of the results of any further tests.

Of course you can easily see why we ask this of you, because, if this cow is allowed to mix with the rest of the herd, it would not be fair for the State to pay for any animals that might contract the disease from her ; at the same time, we do not wish to put any person to the expense of bringing valuable cattle into the State and stop his breeding from them, if he so desires ; in fact, we will be willing to do everything in our power to further the breeding and improvement of cattle in this direction.

Yours truly, John M. Parker, *Secretary*.

The two reacting animals were kept entirely separate from the herd, and had separate yards to run in. On this matter Dr. Kinnell writes as follows: —

PITTSFIELD, MASS., Feb. 19, 1897.

DEAR DR. PARKER: — We were very glad to have your notice of a provisional permission to retain the bull and cow at Mr. Sloane's in quarantine. The bull is kept in a box stall apart from the other houses, a stall specially built for him; the cow will be kept in another stall being constructed for her, and each will have yards to themselves apart from all the other stock. In a few days I will be down there again to see arrangements completed.

On January 2 and 3, 1898, the bull was again tested, with the following result: —

10 P.M., 102.1; 8 A.M., 106; 10 A.M., 106.1; 11.30 A.M., 106.2; 1 P.M., 106.

Dr. Kinnell notes that: —

This bull has been going back for the last four months; does not keep up in condition, and coughs a great deal. I could not by auscultation detect anything but violent percussion made him cough. He has been used on the cows until within a few weeks, and has proved satisfactory in getting the cows with calf. From eight o'clock until eleven this morning he was suffering from a chill, trembling, eyes running and his cough aggravated.

G. N. K.

The test on the cow was as follows: —

Normal temperature, 9 P.M., 101.1; 8 A.M., 103; 10 A.M., 103.2; 11.30, 104.3; 1 P.M., 106.2

The note on this cow is as follows: —

This cow is in good condition, does not cough; but, although she has been served by different bulls, she has not been got with calf.

G. N. K.

This morning from ten o'clock until noon she was suffering from rigors.

Another and most important part of the experimental work has been the work done during the past year by Prof. Theobold Smith at the Bussey Institute. When the office of the Board was moved from Village Street to the Commonwealth building, the laboratory was abandoned and

special arrangements were made with Dr. Langdon Frothingham, at the Harvard Medical School, to do such microscopical work as was found to be necessary. (For Dr. Frothingham's report, see page 119.)

The Board was also anxious to have some original research work done. They felt that it would be well to take up some of the questions in relation to tuberculosis that were still unsettled, and endeavor to throw some further light on them. In this matter the Board had the good fortune to secure the co-operation of Prof. Theobold Smith, and they desire to thank him at this time for his generosity in placing his services at their disposal. The cost of buying and keeping the cattle has been defrayed by the Board, the remainder of the work having been done by him free of charge.

For some time there has been a feeling in certain quarters that it was a serious question whether human and bovine tuberculosis were really identical. There was a dearth of information on this matter, and it was felt that further work should be done in this direction. Consequently Dr. Smith's promise of co-operation was received with a great deal of satisfaction. (For the full report of Dr. Smith's work, see page 126.)

The final results and conclusions drawn by Dr. Smith from his work make it by far the most important work of the year. The report is summed up as follows: —

Leaving these aside, the remaining parts of the test appear to me to be of sufficient uniformity and accuracy to justify us in drawing certain preliminary inferences. We may now maintain that bovine tubercle bacilli and human bacilli as found in sputum are not identical. The difference in their action upon cattle is reinforced by certain differences in the bacilli themselves and their effect upon rabbits, as will be detailed in a fuller report.

What the significance of these divergencies is, what influence they have upon the transmissibility of the disease from cattle to man, we are unable at present to state with any degree of certainty. That they do have some effect must be admitted, in view of results of studies upon other species of pathogenic bacteria. Their precise bearing needs careful investigation.

These studies will, I think, warrant one inference, however; that is, that human sputum cannot be regarded as specially

dangerous to cattle, nor can it be looked upon as a factor in the introduction of tuberculosis into a healthy herd of cattle. Even if the tubercle bacilli of cattle and of man are very closely related and have the same ancestry, as we all must admit, if we regard the two as mere varieties, which may eventually under very favorable conditions pass one into the other, the condition in which the bacillus leaves the lungs in sputum is evidently such as to interfere, *under ordinary circumstances*, with any development in the bovine body. It would fall a speedy prey to destruction.

It is interesting to notice that this work of Dr. Smith's confirms the conclusions arrived at by Dr. Frothingham a year ago. In last year's report, page 57, Dr. Frothingham says: —

From these facts we are certainly justified in concluding that calves are apparently not particularly susceptible to the human tubercle bacillus; but whether this non-susceptibility is due to a bacillus of diminished virulence for the bovine, or to the age of the animals experimented upon, or to some other cause, further experiment must demonstrate.

While it may be conceded that bovines are not susceptible to human tubercle bacilli from sputum, yet it by no means follows that human beings are therefore not susceptible to that of the bovine. At the same time, the great danger of the use of the milk and flesh of cattle suffering from tuberculosis has undoubtedly been greatly exaggerated, for the reason that human tuberculosis has been steadily decreasing during the last thirty-five or forty years, while the bovine tuberculosis has undoubtedly increased during the same period.

It cannot be denied that cows with tuberculous udders or that are extensively diseased, even though no lesion can be detected in the udder, give tubercle bacilli in the milk; and, until it is clearly demonstrated that these bacilli are harmless to the human race, such animals must be looked upon as dangerous to the public health.

From the flesh of tuberculous animals there is much less danger than from the milk, as in this community meat is, as a rule, sufficiently well cooked to destroy the vitality of these germs; while, on the other hand, it is customary to use milk in an uncooked condition. In fact, the danger

from meat is really more from bacilli that may be smeared upon its surface from butcher knives that may have come in contact with tuberculous lesions or infected lymphatic glands than from the flesh itself, as it is doubtful if the muscles ever contain the germs of tuberculosis; but, even if the bovine tubercle bacilli were harmless to the human race, it is not a pleasant thought to contemplate using the milk and meat of animals affected with a disgusting and loathsome disease as food for the people of an intelligent, educated and civilized community.

Considered from a public health point of view, the local inspection work would seem to be sufficient for its protection at the present time, if done in an intelligent and painstaking manner. This is an important work, and on general principles, if for no other reason, it would not seem to be advisable to keep these advanced cases, or cases of tuberculosis of the udder, in the dairy. In fact cows with nodulated udders should be considered as unfit animals for milk production, as such udders, when not tuberculous, may be infected with actinomycosis or pus-producing bacteria, either of which should be looked upon as dangerous.

In this direction the local inspectors seem to have been doing good work, judging from the smaller proportion of cases of advanced generalized tuberculosis that have been found during the year, as compared with previous years.

In removing the animals that are quarantined by the local inspectors year after year, picked out as diseased on physical examination, there is no advance to speak of in diminishing the prevalence of tuberculosis among cattle, as a crop of slightly diseased ones are left behind, which in time may develop the disease, so that the succeeding year an equal number will be condemned; and this may be carried on year after year, to infinity, unless something more than this is done.

This may be accomplished in various ways: first, our cattle owners must be educated to pay more attention to the sanitary surroundings of their stock; they should be taught, if possible, to keep only healthy animals under the most healthful surroundings. Those who take pride in their cattle should strive to keep a herd that will not react to the

tuberculin test, and to buy only animals that have been tested with tuberculin.

The funds appropriated by the State for the eradication and control of contagious animal diseases should first be used for the regular work of the Board, including the expenses attendant upon the taking of such cattle as are found to be diseased which the local inspectors have quarantined. If, after this is done, the Cattle Commissioners have sufficient funds at their disposal, what is known as "voluntary request work" should be done; that is, the Cattle Commissioners may test an entire herd at the owner's request, provided he agrees to buy only tested cattle after those that react are removed, and will also agree to thoroughly disinfect his stable as directed by the Board, and take all such other measures to keep his herd free of the disease as may be recommended.

In doing such work, care must be taken to choose only such farms as have buildings that can be thoroughly disinfected, or where the owner has a new barn into which he wishes to move a herd which suffered from this disease in the old barn. There are many New England farm barns that it is almost impossible to disinfect; here, voluntary request testing is of no value. The owner must either pay more attention to hygiene and cull out the bad cases from time to time, or, if he wishes to entirely eradicate tuberculosis from his herd, he must decide to build a new stable.

A single test is not always sufficient to remove all the diseased animals; hence, a second should follow the first within two or three months. The applicant must understand that it may be necessary to repeat the test, and to repeatedly disinfect in order to have the work successful, and that this requires intelligence, patience, perseverance and some expenditure of money.

There are two sides to the question of dealing with bovine tuberculosis, — one is its bearing upon the public health, the other is that it is an insidious, slow-developing, infectious disease of the bovine, yearly inflicting considerable pecuniary loss upon the dairyman and stock breeder. It has been allowed to continue its ravages unnoticed and unchecked for many years, until we have awakened to the fact that our herds are

widely infected with it; and steps should be taken to reduce it to a minimum in a reasonable and economical manner, in order that the public at large may receive milk as far as possible from healthy animals, and the farmers be protected from pecuniary loss.

The disposal of the carcasses of diseased animals is an important matter. Sections 10, 11 and 15, chapter 491 of the Acts of 1894, provide that the carcasses of diseased animals shall not be used for food. Section 37 gives a list of diseases to be deemed contagious under this act, tuberculosis being among the number.

The Board of Cattle Commissioners has always construed this law to imply that the carcass of an animal infected with tuberculosis, no matter how slight or how localized the lesion may be, is not to be used for beef, but must be either rendered or buried.

This appears to be an extravagant and wasteful ruling, as there does not seem to be any well-grounded objection to the use of the meat from very slightly diseased animals. For instance, a beef may have a tuberculous mediastinal, or bronchial lymphatic gland, no larger than the end of a man's thumb, or even no larger than a pea, and be perfectly healthy in other respects; and yet, under a strict construction of the Massachusetts law, that animal must be rendered or buried. Dr. Theobold Smith makes a division of tuberculous animals into two classes, "*infected*" and "*diseased*." The "*infected*" are those having some slight local glandular lesion, yet enjoying perfect health in other respects. The "*diseased*" are those having more or less well-marked lesions in various organs and glands of the body. The saving would perhaps be more upon animals killed in slaughter houses in condition for beef than among cows killed by order of the Cattle Commissioners, for as a rule milch cows are not in beef condition; at the same time, it must be borne in mind that the local inspectors are apt to have slight lesions escape their notice when a cow is killed for beef, but if a cow is tested with tuberculin, she is hunted from the tip of her nose to the tip of her tail, until the nodule or nodules that caused the reaction are found.

In Germany, France and Great Britain it is the usual

practice to pass as sound all meat from animals in which the lesions are slight or localized; where the disease is general or the carcass emaciated, the meat is destroyed. In this country the United States inspectors of the Bureau of Animal Industry, stationed at the large abattoirs where animals are killed for export or interstate commerce, do the same thing; where the disease is localized, the meat is considered sound; and when the lesions are extensive or generalized, the meat is condemned.

This is an important economic problem, and the propriety of so modifying our State laws regarding the disposal of the products of animals infected with tuberculosis as to have them conform to the rules and regulations of the United States Bureau of Animal Industry for the inspection of meat, should be carefully considered.

Another recommendation for carrying on the work at a less cost has to do with the advisability of reducing the rate of compensation for animals condemned as tuberculous by the Board. In the report of the special joint committee appointed by the last Legislature to investigate the killing of certain cows from Dracut and Lowell, last spring, condemned by the tuberculin test of private veterinarians, the majority of the committee reported as follows: —

From our observations at the investigation, we hold that the Board of Cattle Commissioners should at once take into consideration modifications of the law relative to the condemnation of cattle by tuberculin test alone, — that is, upon the request of owners of cattle for such testing of their herds. If cattle are to be condemned, or regarded as suspicious animals only after they show signs of disease, it is a question as to the propriety or equity of the State paying full value for those that are actually diseased. This proposition we respectfully refer to the consideration of the next General Court, trusting that the Board of Cattle Commissioners will, in the mean time, consider the same question and offer recommendations in their annual report.

In endeavoring to comply with this request, the advisability of any longer paying full compensation must be seriously questioned. The present law provides that full appraised value not exceeding sixty dollars be paid for cattle

killed as tuberculous; "that, whenever any cattle condemned as afflicted with the disease of tuberculosis are killed under the provisions of this section, the full value thereof, at the time of condemnation, not exceeding the sum of sixty dollars for any one animal, shall be paid to the owner thereof out of the treasury of the Commonwealth, if such animal has been owned within the State six months continuously prior to its being killed; provided such person shall not have, prior thereto, in the judgment of the Cattle Commissioners, by wilful act or neglect, contributed to the spread of tuberculosis; but such decision on the part of the commissioners shall not deprive the owner of the right of arbitration as hereinafter provided." (Section 45, chapter 491, Acts of 1894, as amended by section 10, chapter 496, Acts of 1895.)

This is a very delicate question, and one requiring to be handled with the greatest care. In many instances it is found that from some localities certain names appear upon our books more frequently than any other persons, seeming as though special individuals found it profitable to buy suspicious cows and sell them to the State at an advance on the purchase price.

Then, again, certain farmers last spring employed veterinarians to test cattle, with the idea, in many instances, of selling unprofitable cows to the State, and using the money to buy new ones that had not been over grained and milked out, leading to passage of act to prevent owners receiving compensation for cows, etc.

No person having animals tested with tuberculin shall be entitled to compensation from the treasury of the Commonwealth for any animals that react to the tuberculin test, unless such testing be done by the State Board of Cattle Commissioners, or their authorized agents acting as such at the time of the test; and such testing shall be subject to the supervision and control of the State Board of Cattle Commissioners.

Furthermore, local inspectors quarantine cows on suspicion that show no physical evidence of disease, which react to tuberculin, are killed and found to have some slight lesion. The owner puts a new cow in place of the old one, that may not be free from tuberculosis, or, if she is, may in six months

be diseased to the same extent (or more) as the old one, if he has neglected to disinfect the place where the old one stood, or has been careless about it. This would not be the case in any of the above instances, if compensation were not paid in full.

The wisdom of paying full compensation for cattle that react to tuberculin is doubtful, except perhaps in cases where an owner is compelled to have his whole herd tested. If partial compensation only were paid, fewer cattle would be killed by the commission, and at a less proportionate cost to the State, giving more opportunity to test herds for owners who wish to eradicate tuberculosis, which our funds do not allow us to do now. Moreover, there would be no applications, under reduced compensation, for voluntary request tests, except from those who were sincere in their desire to eradicate tuberculosis from their herds, as part of the loss would fall on the cattle owner, and he would not be willing to incur his share of the loss unless he was honest in his wish to rid himself of this disease, which Professor Walley enumerates as one of the "four bovine scourges."

Scientists in various countries have been working for a number of years, and still are, to discover an immunizing or curative agent for tuberculosis; and it is possible that in time, perhaps in a few months and perhaps after the lapse of several years, a material may be produced with which cattle may be rendered immune from tuberculosis, or that even tuberculous cattle may be cured. When these discoveries are made, it will certainly be the duty of the State to avail itself of them. Under the present law, the Cattle Commission has power to create quarantine stations and to experiment with animals in the study of contagious diseases; hence it would seem that the Board has discretionary power to change its methods with the advance of modern scientific research. Meantime, we have tuberculin as a fairly reliable diagnostic agent; it should be used to verify the diagnosis on cattle condemned as tuberculous on a physical examination; and where owners of herds are desirous of eradicating this scourge from among their cattle, we know it can be done where the test is applied two or three times, and the owner complies with the laws of hygiene and has a barn that can

be properly disinfected. We also know, from Bang's experiments, that when a breeder exercises intelligent care it is possible to raise a healthy herd from a diseased one, and in the mean time much can be done in an educational way to improve the existing conditions.

Ordinarily, for the transmission and development of tuberculosis among dairy cattle long and intimate association is required. This close and intimate association of the diseased with the healthy is a condition that commonly exists on the average New England farm, the frequency and seriousness of the infection depending on the amount of infectious material present and on the susceptibility of the different individuals in the barn.

When an animal inhales the dust containing the tubercle bacilli, the bacilli are absorbed through the mucous membrane lining the air passages, and usually find lodgement in the bronchial or mediastinal glands. The presence of the bacilli in these glands, or the constant reinfection from the introduction of new bacilli, stimulates the cells immediately surrounding the bacilli, and the result is that a nodule, or tubercle, is formed. The disease may not go any further until from some cause the resisting power of the animal is weakened; the disease may then develop, and the animal finally falls a victim to tuberculosis. That this is ordinarily the course of the disease is borne out by the fact that in by far the larger number of cases the thoracic glands are found to be the initial seat of the disease, and frequently on post-mortem examination the animal is found to be only very slightly infected. Under such conditions it follows that every precaution should be taken to prevent the development of these slight localized cases, and anything that tends to undermine and weaken the health of the animals should be avoided.

In attempting to prevent the spread of the disease, one of the most important matters to be attended to is to endeavor to reduce the amount of infectious material present in the barn, for of course the greater the amount there is present the greater the likelihood that the cows in that barn will become infected; and, in endeavoring to reduce the quantity of this infectious material, it should be recollected that disinfection

and washing are not the only methods that should be adopted.

When a ray of light penetrates a dark room, innumerable particles of dust may be seen floating in the air; these particles of so-called dust are organic matters given off by the occupants of the barn, as well as fungi, bacteria and particles of hay, grasses, etc., which make good carriers for the various forms of bacteria; and it is this dust that is so dangerous as a source of infection in tuberculosis.

This can be better realized, perhaps, when it is pointed out that the manure is, and must be considered, one of the dangerous factors by which the disease is spread in the stables: it very frequently contains the tubercle bacilli, and when it dries it becomes pulverized and powdery, and along with the discharges from the nose it mixes with the dust and chaff, and when stirred up it is carried in the air and is breathed by the cattle, which are frequently kept tied in the barn all winter long without any form of exercise. Under such circumstances the circulation naturally becomes sluggish, less oxygen is required by the body, the breathing becomes shallow and the lungs are not expanded; and when any extra strain is put upon them they are unable to do their work, and we have rupture and permanent dilation of the air cells, along with weak lungs and a predisposition to pulmonary disease. In other words, we have just the condition most suited to the development of tuberculosis, and at the same time the animal is breathing an atmosphere impregnated with infectious material.

Bearing this in mind, then, one can readily see how important it is to thoroughly ventilate the barns. When the hot, foul, infected air is continually being diluted by fresh outside air, of course the continual dilution lessens the proportional amount of infectious material in the air, and therefore lessens the danger from its inhalation; and not only is there less danger from infection, but the health of the animals is better. When only a small quantity of Co_2 is contained in the air, the Co_2 in the lungs is very readily diffused through the atmosphere; but when that atmosphere has become impure, when it contains a large quantity of Co_2 with organic impurities, then the Co_2 in the lungs is not so

readily diffused through the air; it sooner finds its level and is retained in the system, where, from want of oxygen, the vitality is lowered and the dulness and lethargy experienced such as is felt by any one after sleeping all night in a close room.

Most farmers that object to the admission of fresh air in their barns do so because they say that cold barns and cold draughts blowing on the cattle will check the flow of milk; but it is not necessary to have these cold draughts. Judgment must be used to see that the admission of the fresh outside air does not cause draughts; the volume of the incoming air should be broken up and evenly distributed through the barn, so that currents of cold air and draughts are avoided. The question of the absolute necessity of good ventilation and pure air, and its influence on health, is not merely a theoretical one, but, as will be shown later, its immense influence on health and disease can easily be demonstrated.

The want of drainage and the presence of dark and damp cellars under the barns is another matter that bears a close relationship to the warmth and comfort of the barn. The cellar is usually dark and damp; the sun never shines there, and either the drip from the floor above or the surface drainage from the yard keep it in a continual state of moisture. This continual dampness below the barn is in a great measure responsible for the cool, chill feeling that one often feels on entering a barn. The cellar is never drained; it dries only by evaporation, and the feeling of chill that one experiences is a direct result of the warmth being used up in the work of evaporation. One hardly realizes what this amounts to; but we are told by Professor Kedzie (New Hampshire Board of Health report, 1893, Vol. II.) that: —

To evaporate one pound of water consumes enough heat to raise the temperature of five and one-half pounds of water from freezing to boiling point; or, to vary the illustration, suppose that a tile drain discharges constantly for one day a stream of water whose cross-section is one square inch and velocity two and one-half miles an hour, — this *one day's drainage* alone would save the heat equivalent to nearly six tons of coal.

Further, we must remember that barns are usually warm; this warmth causes a current of air upwards, so that this damp, chilly air is drawn up into the barn above, where it does the most harm. In referring further to damp surroundings, Professor Kedzie again forcibly remarks: —

The *evaporation* of so much water renders the air over such a soil damp and chilly. The result is a physical necessity. This damp and chilly atmosphere has a more serious result than the simple feeling of discomfort. It has a most depressing influence on the human system, lowering its tone, enfeebling the vital powers, and acting as the predisposing cause of a long list of diseases, some of them the most destructive and incurable known to the medical profession. The depressing influence of the dampness and chilliness of a water-soaked soil is not to be compared to the effect of an occasional wetting, as when we are caught in a shower. The chilly dampness of the undrained soil is persistent and unremitting, dragging us down with its cold fingers at all hours, at "noon of day and noon of night," as if we toiled and rested, waked and slept in a perpetual drizzle of cold rain. It may seem a small force at first, but its persistent, untiring and relentless pull tells upon the strongest at last, like the invisible fingers of gravity which finally drag down all to a common level. This depressing influence is not developed suddenly and distinctly, but silently and secretly the sapping and mining go on, till the explosion comes in sickness, suffering and the sleep that is eternal.

If it is necessary to have cellars, then it is necessary that the floor of the stable should be water-tight; that the cellar should be well lighted and ventilated; that both cellar and subsoil should be well drained; that the manure, instead of being dumped into the cellar, should be taken some distance from the barn, and the liquid taken up by absorbents or carried to a cesspool, where it can be made use of, instead of going to waste by soaking into the subsoil below the barn.

Light is another essential in the thorough disinfection of barns that is too often neglected. The majority of barns have only one or two small windows, rarely larger than say eighteen or twenty-four inches square, usually thick with dust, and giving a "dim, religious light," or none at all. Only very few barns have windows sufficiently large to give free admittance to the sunlight. Owners of cattle do not

seem to realize that sunlight is just as essential to the health of animal life as it is to plant life. There is no reason why barns should not be as light as dwelling-houses; and the responsibility for its exclusion from barns must rest with the old theorists, who claimed that cattle would fatten and do better when kept in the dark than when exposed to the light. It has seemingly taken a long time for this idea to be abandoned, and even at the present time it seems to be impossible to teach some people that light is not detrimental to the health of dairy stock. It is especially necessary where, through want of fresh air and exercise, the circulation is sluggish and the system depressed.

Light stimulates the circulation, and with increased oxidation more Co_2 is given off and the functions of the whole body are quickened and enlivened; but sunlight also retards the growth of germ life, and the vitality of certain forms of bacteria, *including tubercle bacilli*, is destroyed in a few hours' time by the direct action of the sunlight. Sunlight is not only the best, but the cheapest, disinfectant we know.

In referring to the question of sanitation and tuberculosis, Dr. James Russell, in the report of the Glasgow Board of Health, says that: —

> The death rate from "phthisis" has fallen from 2,849 per million to 2,316, and from other tubercular diseases from 1,090 per million to 884, in both cases 19 per cent., — a result which quite casts into the shade the improvement in Prussia and Saxony, quoted from Cornet, which he puts to the credit of special prophylaxis. Clearly, then, we are warranted in asserting that among infectious diseases tuberculosis is the most amenable of all to general hygienic measures; that, in fact, from these alone as good results are obtained as from hygienic measures plus isolation, disinfection, etc., in the case of diseases popularly known as infectious. It is not implied that special measures directed against the infectivity might not have produced even better results; but in view of what has been accomplished, and in view of the difficulties in the way of special prophylaxis, it is contended that more is to be expected from general hygiene.

The New York Medical Record (Dec. 30, 1893), in referring to sanitary conditions in Great Britain, says: —

The average annual death rate throughout England and Wales during the twenty years previous to 1870 did not vary greatly from 22.5 per 1,000 of population; and it was estimated by Mr. Simon that 125,000 persons died each year of diseases due to defective sanitary conditions. Although Simon's figures were thought by some to be exaggerated, they nevertheless had great weight in persuading Parliament to adopt the reforms recommended by him. During the next twenty years extensive improvements were carried out on a large scale, with the result that in 1889 the mortality had fallen to 17.9 per 1,000, thus more than justifying the calculations of Simon.

In referring to this same subject, Prof. F. Smith of Aldershot, in his "Manual of Veterinary Hygiene," says: —

The mortality amongst the horses of the French cavalry was at one time frightful; previous to 1836 they lost 180 to 197 per 1,000 per annum; the air space being increased reduced the losses in the next ten years to 68 per 1,000.

The following table* shows the number of cases of lung and glanders diseases among the horses of the French cavalry from 1847–66, a period of nineteen years: —

	1847-52 Ratio per 1,000.	1853-56 Ratio per 1,000.	1857-61 Ratio per 1,000.	1862-66 Ratio per 1,000.
Glanders, ...	23.32	21.44	10.97	7.24
Inflammation of lungs and pleura, . . .	104.7	110.6	45.8	3.59

This table shows that in nineteen years a reduction of 16.08 per 1,000 had occurred in cases of glanders, and no less than 101.11 in cases of pneumonia and pleurisy. These wonderful results were obtained through the labors of a Commission of Veterinary Military Hygiene, which pointed out the necessity of the ventilation of stables, increased cubic capacity and attention to sanitation, feeding and general care. The practical outcome of these results was that a saving of £90,000 per annum was effected in the purchase of horses alone.

* Copied from a most interesting and valuable paper on "The Vital Statistics of Cavalry Horses," by Dr. Balfour, F.R.S., "Journal of the Statistical Society," June, 1880.

The only explanation of the great difference in the mortality is the larger amount of pure air supplied, and the better ventilation of the stables.

And again, in the report of the State Board of Health of New Hampshire for 1892, in speaking of this matter, it says: —

There is no doubt of the great mortality from consumption in persons living in badly ventilated rooms. A few years ago the proportion of deaths among the soldiers of European armies from this cause was very high; but now, owing to better ventilation, the other conditions remaining the same, the percentage has greatly fallen. In one regiment in England, when the barracks were not ventilated, the death-rate for lung diseases was 12½ per 1,000; but after efficient ventilation had been introduced it fell to 1½ per 1,000.

Parkes gives a similar example from two hospitals in Vienna. In one, very badly ventilated, of 4,280 prisoners, 220, or 51.4 per 1,000, died of consumption; of these, 42 of galloping consumption. In the well-ventilated hospital, of 3,037 prisoners, 24 only, or 7.9 per 1,000, died of the same disease. The conditions in the two hospitals, excepting ventilation, being alike, the badly ventilated one had six and a half times as many deaths from this cause alone as the better-aired one.

The statistics collected by Dr. Buchanan on this subject are also instructive: —

In Salisbury, England, after the introduction of improved drainage, the annual death rate from phthisis fell from 44½ per 10,000 to 22½ per 10,000 between 1857 and 1864. In the same period of time, in the towns of Ely, Rugby, Worthing, Macclesfielf, Leicester, Newport and Banbury, the death rate from phthisis fell 47, 43, 36, 51, 52, 52 and 50 per cent., respectively, in consequence of improved drainage alone.

The importance of this matter is also shown in the report on the experimental work by Ernst and Peters, at Mattapan, where, in referring to the effect of improved sanitary conditions on diseased cows, it says: —

Before the farm buildings were used at all, they were thoroughly cleaned from top to bottom. Every portion of old manure was carted away, as well as all the old earth. The whole of the wood-

work was scrubbed and then washed with corrosive sublimate solution (1.1000) and finally whitewashed, and every care taken to secure good drainage and ventilation. The result and effectiveness of all this have been best demonstrated by the fact that every animal brought to the place made a most marked improvement in its general condition, while some of them even went so far as to appear to get well. (Ernst.)

The same thing is shown in the case of some cattle at Mr. French's farm at North Andover, where several animals were slaughtered after testing with tuberculin; a number of the remaining animals that reacted to the tuberculin test were turned out to pasture, and in the fall they were brought in and retested by the State authorities, and they failed to react, the recovery evidently having resulted from the open-air life in pasture during the summer months.

A similar incident is related by Professor Law. He says: —

In 1877 I recognized the existence of tuberculosis in the Jersey herd of Burden Bros. of Troy. The worst were slaughtered, but some incipient cases in young animals were turned out in a pasture by themselves, where they passed the summer in apparently robust health, but they began to droop when returned to the barns in the fall. (Paper by Prof. James Law, read at Peterborough, N. H., December, 1892.)

These are only a few of the examples showing the great influence that the surroundings have on the health of the animal body; pages of statistics could be quoted and figures given showing the same results, but that would only be an unnecessary repetition, as the immense importance of good sanitary and hygienic conditions is generally accepted by every one.

In suggesting improvement on the present method of constructing dairy barns, cheapness of construction and convenience in handling, as well as the health of the stock, have been borne in mind. Of course these ideas can be elaborated or modified according to the wealth of the owner and the amount of money to be expended on the buildings; but, whether the cost is to be great or small, it is absolutely necessary, if the health of the cattle is to be maintained, that there should be pure air and good ventilation, as well as

sunlight, drainage and dryness in and around the farm buildings.

In building new barns, many progressive farmers have adopted the idea of using the old barn for storage purposes, and stabling the cattle in a one-story building or shed adjoining. This arrangement admits of many advantages; it is more easily ventilated and lighted, it has no cellar, the hay and food is not contaminated with the odor from the cattle, and it is an economical form of construction and can be erected at comparatively little cost.

Among the more expensive examples of this form of construction may be mentioned the cattle barn at the Lyman School for Boys, at Westborough. The cow stable at the Millwood Farm, Framingham, is another good example of this form of barn. It is unusually well lighted and ventilated, and simple in design and construction.

In making calculations as to the amount of cubic space required for each animal, we should remember that each cow uses approximately 1,000 cubic feet of air per hour. Now of course, if the barn admits of each cow having 1,000 cubic feet of air space, then the air in the barn will need to be renewed each hour; and of course, if the air space provided is less, then correspondingly the supply of fresh air will need to be more frequent; but where the cubic space is greater, the supply may be less frequent. The problem, then, is to carry away the foul, impure air, and to supply each animal with 1,000 cubic feet of fresh air each hour in such a manner as not to cause a draught on the animals. To do this, the air must not be admitted in bulk, nor must it move at a greater speed than 3 feet per second, — in fact, the slower and more imperceptibly it moves into the barn, the less draught will there be.

Many farmers attempt to admit fresh air by keeping door or windows open; the result is that a body of cold air finds its way in and falls directly on the back of the cattle; the cattle stand and shiver, and curl up, look miserable, and fall off in their milk; and the farmer is discouraged, and makes up his mind that fresh, cool air does no good to the cattle, but rather does harm, and he won't admit any more than he can help. To prevent such a condition of affairs, and to

keep draughts from the cattle, fresh air should either be admitted high up, or should be directed upwards so as to become tempered before it falls. By directing up toward the ceiling, by admitting it in small openings, and by breaking up draughts and currents of air by louvre boards, air will be diffused through the building, and large quantities of air can be admitted without causing any appreciable draughts or other ill effects.

A good method of introducing fresh air is by wooden pipes or boxes placed below the floor opening outside, and having the external opening screened to keep out the dust. These should communicate with upright boxes opening well up in the barn, the opening directed upward and broken up with louvre boards, or screens, or netting at the top to break up the current of air and distribute it.

Ventilators, or openings for the foul air to escape, should always be at the highest part of the roof. The openings should be protected so that the wind will not blow down and check the upward current of foul air, but the wind should be utilized so as to cause a partial vacuum on the lee of the building, or ventilator; the vacuum thus caused will have a tendency to suck the foul air up and out of the barn. Thorough ventilation is of course much easier to accomplish when the building is heated by artificial means; but by taking advantage of the wind and the natural warmth of the barn, much can be accomplished even without artificial heat.

One of the best points in the Millwood Farm buildings is the good window space. In building barns, owners should remember that they cannot have too much light, and windows do not add enough to the cost of the building to counterbalance their great benefit.

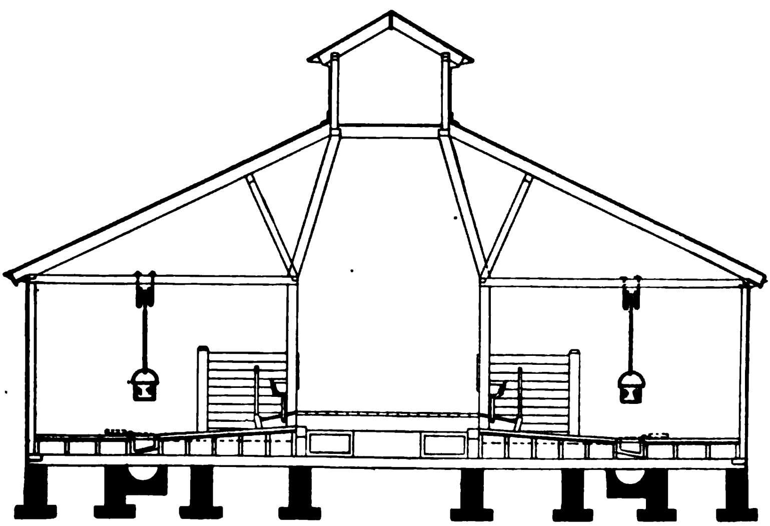
A practical point in the arrangement of this barn is placing the calf pens next the window, and in this way protecting them from being broken by the horns of the passing cows.

The floors, and especially the manure gutter of barns, should always be tight; otherwise the liquid manure will saturate the floor below the barn, besides wasting a valuable fertilizer. As a matter of economy, if for no other reason, arrangements should always be made either for the absorption of the liquid portion or for carrying it to a tank or

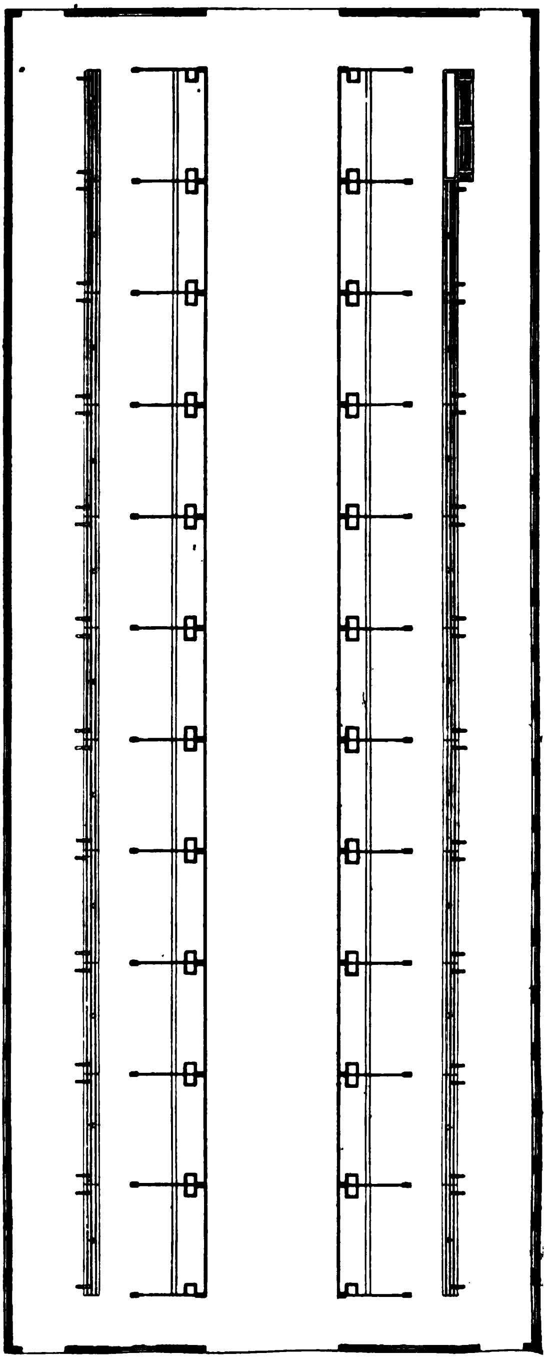
cesspool, where it can be stored until drawn off and spread on the land.

In presenting the following sketch of a cow stable, it has been the purpose of the Board to submit ideas of a stable

which is adapted to most of our Massachusetts farms; and, while it has been our intention to leave out nothing that enters into the comfort and healthfulness of the animals, we



have aimed at a building of small cost, in which it is possible to handle the herd with economy. On most of our farms the stable can be built onto the end or side of the present



barn, thereby utilizing the old barn for storage of fodder, and also using the cellar under the old barn, if there be one, as a dump for the manure. The plan provides for a drive through the centre of the stable, for purpose of feeding; for raised cribs adjoining the floor or feed walk, whereby a herdsman can not only have his eyes on the feeding of every animal, but he will feed and clean the cribs of forty cows in such a stable easier than five where fed in box cribs, and do it more perfectly and easily, and his work can be inspected at a glance; for a self-watering device, giving the advantage of having a constant supply of water before the cattle at all times; for a slanting manure gutter, in which the cows will seldom stand; for a stable which is very light and well ventilated.

Texas Fever.

During August a number of cases of Texas fever occurred, thirty-five head of cattle dying that were reported to the Board of Cattle Commissioners, with the possibility of a few other animals having died that were not reported to the Board. These cases were confined entirely to three carloads from New York State, as follows: —

On August 2, E. N. Smith of Watertown brought a carload of nineteen cows from Herkimer County, New York, of which number thirteen died within fifteen days of Texas fever. These animals were sold to different parties, and went out into the country into herds owned by the following persons: –

C. A. Dennen, Pepperell,	2	
Jonathan Davis, Sterling,	1	
Mr. Lumnie (sold to McGowan), Dedham,	3	
Mr. Horton, Fall River,	3	
W. J. Navell, Lexington,	1	
A. S. Gushee, Dorchester,	1	
Cash (name of purchaser not known),	1	
George Durth,	1	
	—	13

On August 9, Geo. N. Smith of Watertown brought a load from Jefferson County, New York, consisting of seventeen cows and one bull. Of these, the following animals died, bought by persons whose names are here given: —

C. A. Dennen, Pepperell,	1	
E. B. Wilbur, West Bridgewater,	3	
Walter Dennis,	1	
Wm. Bowen, Providence, R. I.,	2	
	—	7

All of these died within fifteen days from the day they were landed at Brighton.

On August 16, Geo. N. Smith brought another car-load of twenty-two cows from the same place. Of these, fifteen died; two others were very sick, but have partially recovered. These were bought by: —

H. E. Eames, Framingham,	7*	
J. Berry, Cambridgeport,	1	
Warren Davis, Needham,	1	
John Swinerton, Danvers,	2	
J. S. Henry, Watertown,	5	
	—	15
		—
Total,		35

The loss of these animals and the source of their infection seemed to the members of the Board to be so serious a matter that it was decided to employ a special agent, having expert knowledge of this disease, to investigate this outbreak, and make a full report concerning it.

The services of Dr. Cooper Curtice of Moravia, N. Y., were secured, he being a former employee of the Bureau of Animal Industry, United States Department of Agriculture, and having had an extensive experience with Texas fever and a broad knowledge of its cause and mode of extension. Dr. Curtice commenced his labors for the Board of Cattle Commissioners September 18, and brought them to a close on October 9, making his report with the following letter of transmittal October 11: —

MORAVIA, N. Y., Oct. 11, 1897.

DR. AUSTIN PETERS, *Chairman, Massachusetts Cattle Commissioners, Boston, Mass.*

SIR: — I send by this mail my report on the outbreak of Texas fever in your State. I have included some remarks upon the pre-

* 6 died.

vention of future outbreaks. While they seem to reflect strongly upon the management of the United States Bureau of Animal Industry, I trust that the presentation of the facts will not only enlarge the present duties of these United States officers, but call the attention of your State and others to the need of more careful work being done by them. Public officials often fail to do what they themselves deem right, because of failure of funds and a public opinion that will sustain them in their action.

I am, very respectfully, yours,

COOPER CURTICE,
Veterinarian.

The history of the source, transportation, distribution and subsequent deaths of the cattle concerned in the outbreak in eastern Massachusetts, obtained mainly through the efforts of Commissioner Dennen, is as follows: —

First Carload. — Mr. E. N. Smith of Watertown, Mass., bought nineteen cows in Herkimer County, New York, from five different men, as follows: -

Will Cotter, Little Falls, N. Y.,	9
A. L. Eaton, Little Falls, N. Y.,	6
V. Farrell, Newport,	1
James Moone, Coldbrook,	2
James Doyle, Newport,	1
	19

These were shipped from Herkimer, N. Y., consigned to Brighton, Mass., in a Rome & Watertown car No. 10028. They arrived at West Albany stock yards on Sunday, August 1, where they were unloaded to be fed and watered, and driven into pen 16, alley D, for a few hours. They were then reshipped to Brighton stock yards, where they arrived Monday night, August 2. They were driven into pens 11 and 13, Texas alley, and thence into pens 34 and 35, thence they were released and distributed to the surrounding country. Thirteen head out of the nineteen thus handled died soon after. One cow died on August 11, one on August 12, three about August 14, one on August 17, and one on August 20.

Second Carload. — Mr. Geo. N. Smith of Watertown, Mass., bought seventeen cows and one bull in Jefferson County, New York, from thirteen farmers, as follows: —

Rush Pennal, Pamelia, N. Y.,		1
Mr. Zimmerman, Pamelia, N. Y.,		1
C. Klock, Pamelia, N. Y.,		1
Wm. Reese, Evans Mills,		2
D. A. Rich, Watertown,		1
Wm. Weale, Watertown,		1
Charles Hawley, Ellisburg,		2
George Butts, Ellisburg,		2
Mr. Scott, Ellisburg,		1
John Eastman, Ellisburg,		1
A. O. Davis, Ellisburg,		1
Mr. Griffin, Rutland,	1 bull,	2
Charles Ferguson, Rutland,		1
	1 bull,	17 cows.

These were shipped from Watertown, N. Y., consigned to Brighton, Mass., in Rome & Watertown car No. 10033. They arrived in West Albany stock yards on Sunday, August 8, where they were unloaded and driven to pen 16, alley D. After a few hours they were reshipped to Brighton stock yards, where they arrived Monday night, August 9, and were driven into pens 11 and 13, Texas alley; thence into pens 34 and 35, to be distributed to the surrounding country. Of these eighteen head, seven died: two on August 18, one on August 22 and two others about the same time.

Third Carload. — Mr. Geo. Smith bought another carload of cattle, consisting of twenty-two cows, from twelve different farmers in Jefferson County, as follows: —

Mr. Colon, Cape Vincent, N. Y.,	1
"Abe," Cape Vincent, N. Y.,	2
Mr. Vincent, Cape Vincent, N. Y.,	3
Mr. Walker, Cape Vincent, N. Y.,	2
Louis Ives, Freed settlement,	1
W. R. Smith, Antwerp,	4
David Taylor, Antwerp,	1
Mr. Mason, Antwerp,	1
Wm. Umpstead, Freed settlement,	4
D. A. Rich, Watertown,	1
John Leahr, Dexter,	1
L. Hill, Dexter,	1
	22

These cattle were shipped from Watertown, N. Y., consigned to Brighton, Mass., in a New York Central car No. 23897 or 23015. They arrived at West Albany stock yards Sunday, August 15, where they were driven into pen 17 D. After being rested, fed and watered, they were reshipped, and arrived in Brighton Monday evening. They too were driven into pens 11 and 13, Texas alley; thence into pens 34 and 35, whence they were distributed. Of these, fifteen died: three before August 27, six before August 31, and two recovered.

The above three carloads of cows were all that have been reported as having been affected with Texas fever, that were distributed in eastern Massachusetts.

The diagnosis of Texas fever in the dead cattle has been made on the following data: —

1. Specimens of spleens and kidneys of two cows, owned by Commissioner Dennen of Pepperell, were examined by Dr. Frothingham, pathologist to the commission, and the micro-parasite (*Pyrosoma bigeminum* Smith), the cause of the disease, was found. This diagnosis was confirmed by Dr. Theobold Smith, pathologist of the Massachusetts State Board of Health, the original discoverer of the cause of the disease. Mr. Dennen lost three cows.

2. Specimens from a cow owned by Mr. Eames of Framingham, Mass., and submitted by W. P. Mayo, also yielded the micro-parasite upon examination by Dr. Frothingham. Mr. Eames lost six cows; one other was sick, but recovered.

3. Specimens of spleen from cow owned by James McGowan of Dedham, Mass., and submitted by Dr. G. B. Foss of Harvard Veterinary Hospital, also yielded the micro-parasite to Dr. Frothingham. Mr. McGowan lost three cows of the same disease.

4. Commissioner Dennen secured a full-grown cattle tick (*Boöphilus bovis* (Riley sp.) Curtice), about the middle of September, from one of Mr. Eames' cows that recovered from the disease.

The positive determination by the finding of the micro-parasite in four animals involved in this outbreak, and the finding of the tick on the recovered animal, fully demonstrates the outbreak to have been due to Texas fever.

A fourth carload of cattle, taken from northern New York to western Connecticut, suffered with the disease, and the facts of the outbreak have been gathered in fulfilling your directions on this point. These facts were given by Mr. W. B. Sprague, commissioner on domestic animals, Hartford, Conn., Mr. D H. Canfield, Bridgewater, Conn., of the firm of Odell & Canfield, the cattle dealers who imported the cattle, and others.

Fourth Carload.—Mr. M. W. Odell of Roxbury Centre, Conn., bought eighteen cows, nine heifers and four calves in St. Lawrence County, N. Y. They were shipped from Norwood, N. Y., consigned to New Milford, Conn., *via* Utica, in New York Central car No. 22931. They arrived at the West Albany stock yards Sunday, August 1, and were driven into pen 15, alley D, to be fed, watered and rested. They remained here until Monday, August 2, when they were reshipped to New Milford, where they arrived Tuesday, August 3. They were then driven to Mr. Canfield's farm, two miles south-east of New Milford. On the 4th of August they were driven to Roxbury, and kept on Mr. M. W. Odell's farm, separate from other cattle. The distribution of these is as follows: —

August 5, H. N. Allen, Pawling, N. Y.,	2 cows, 2 died.
August 5, Wm. O'Brien, Roxbury, Conn.,	1 cow, 1 died.
August 5, Alonzo Whitehead, Roxbury, Conn.,	1 cow.
August 5, Chas. Botchford, Roxbury, Conn.,	2 cows, 1 died.
August 9, G. W. Hurlburt, Roxbury, Conn.,	2 heifers.*
August 16, Anthony Mazotos, Naugatuck,	1 cow.
September 9, C. H. Sanford, Bridgewater,	1 cow.
September 15, Chas. Botchford, Roxbury,	1 cow.
October 1, now in lot, Roxbury,	5 cows.
October 1, now in lot, Roxbury,	5 heifers.
Buried in lot,	3 heifers, 3 died.
Buried in lot,	3 heifers, 3 died.

It is thus apparent that, of the twenty-seven head, ten died. One heifer was temporarily sick, but recovered. Mr. Odell found five ticks upon her, each half as large as the little finger nail. A careful search yielded none on October 1, the time of my inspection.

The following notes will indicate the character of the disease, and the post-mortem appearances as near as can be arrived at: —

Mr. O'Brien's cow was taken sick Friday, August 13, and died Sunday night, August 15. She was examined Monday morning. The flesh looked well; the spleen enlarged, soft, pulpy and dark; the gall bladder large, with thickened contents; the kidneys dark, even black; the lungs and heart perfectly healthy; the intestines all right; the bladder full. Mr. O'Brien reported that the cow passed dark-red water while sick.

Mr. Odell's cow calved August 14, and seemed well, but did not come to her milk. She first appeared sick Monday, August 16, and died Tuesday night, August 17. She passed red water on

* Two years old.

August 15. She was examined by Mr. Canfield, Mr. Odell and Dr. R. S. Todd, of New Milford. The symptoms were almost identical with those of the O'Brien cow.

On Tuesday afternoon, August 17, one cow was found dead in the pasture, and two missing. The missing cows were found Wednesday; one was dead, the other sick.

On Thursday, August 19, a three-year-old heifer was examined in the presence of Commissioner Sprague, Mr. Canfield and others. She had the same appearances as the O'Brien and other cows. One cow was observed to be sick August 19, while the commissioner was there. She died Saturday, August 21.

Messrs. D. H. Canfield and H. M. Canfield, South Britain, saw ticks on the Odell cow. They were about the size of wheat grains. Dr. R. S. Todd, veterinarian, of New Milford, Conn., saw the post-mortem of Mr. Odell's cow: "The intestines were empty; the manifolds baked; the lungs and heart normal; the liver and spleen enlarged; bladder filled with black urine; gall bladder filled with cheesy gall."

He also saw two others, which he says were in almost the same condition, but the spleens not nearly as large. They were, however, larger than normal, and dark. One had yellowish cast to liver. The temperature of cows that he took ranged from 105° to 106.4° F. One, an Ayrshire, was sub-normal, 96° F. This cow died that night, after Dr. Todd left.

Mr. Walter Booth, a butcher, opened at least three cows. All had red water in bladder; one had a very soft liver; one had very black gall; the spleen in one was about twice the usual size, others larger than usual.

Though the determination of the cause of death in these cattle is not as scientifically accurate as in the case of the Massachusetts cattle, there is little room for doubt that these cattle also died of Texas fever. The history of transportation through pen 15, alley D, at West Albany, where, as will be maintained hereafter, a carload of quarantine cattle, shipped to New York, June 18, were fed and watered; the clinical development of the disease; the gross post-mortem appearances, as detailed to me by Dr. Todd, Mr. Canfield and Mr. Booth; combined with the finding of ticks attached to cattle by at least three men, — practically decide the diagnosis.

On my return to Albany, Saturday, October 2, another set of facts bearing upon this outbreak, and in line with the above, was brought to my attention.

In the investigation at Albany and in New York State I have had the hearty co-operation of Mr. Charles A. Wieting, commis-

sioner of agriculture, and Mr. G. D. Flanders, assistant commissioner, who detailed Dr. Wm. H. Kelly of Albany, N. Y., to investigate the outbreak for the State. Saturday noon, October 2, Dr. Kelly took me to see a patient in his private practice. A cow owned by the Little Sisters of the Poor was lying nearly dead. She was bought about ten days earlier at the West Albany stock yards, but had been in the stable seven days. She was originally owned by the Shaker Settlement near Albany, and had been around the stock yards for three or four weeks. On the Thursday preceding she had been taken violently ill with chills, and had passed red water. This cow died that afternoon, and, by arrangement made by Dr. Kelly, was post-mortemed at a rendering establishment outside the city.

This cow's muscles were bright, as if partially bled; the lungs were normal, excepting a small area in the posterior portion, which was partially hepatized; the heart was firmly contracted, its muscles being quite pale; the posterior mediastinal and the left bronchial lymphatic glands contained a few one-fifth-inch diameter caseous gritty foci of tubercular origin; the spleen was from three to four times enlarged, with the characteristic blackberry-jam appearance on section; liver much enlarged, with decided yellowish cast; gall bladder full, gall thickened; intestine with reddish or pinkish appearance; kidneys very dark on section; bladder full of dark-red urine; uterus, with black contents, showing the animal to have calved recently.

Cover-glass preparations made from the heart muscles yielded the micro-organism of Texas fever to Dr. Frothingham, October 5. Portions of the heart, liver, spleen, kidney and the entire bladder were submitted to Dr. V. A. Moore, pathologist of New York State Veterinary College, by Dr. Kelly, for examination. A close inspection of the skin discovered a single female tick *Boöphilus bovus*, but little more than two weeks old.

The known details of the transportation and of the outbreak of Texas fever having been given, it becomes necessary to outline the principal features of the scientific history of the disease, that the two may be compared and a working theory advanced to discover the source of disease. This presentation is founded upon the investigations of the scientific force of the United States Bureau of Animal Industry, from 1886 to 1896, and various earlier writers upon this subject.

It has long been known that cattle from the south Atlantic seaboard and Gulf coast States, though seemingly and actually healthy, had the property of infecting the ground whenever driven or transported into mountainous countries or the northern States,

so that native cattle when grazing or resting upon the infected places contracted the disease known to the United States government as Texas fever, but to farmers as "red water," "bloody murrain" or "tick fever."

The actual cause of the disease (the micro-parasite *Pyrosoma bigeminum*, Smith) was demonstrated in 1889. The proof that cattle ticks (*Boöphilus bovis* (Riley sp.) Curtice) carried this disease from one animal to another followed a year or two later.

A complete cycle of an outbreak of this disease is embraced between the time that it leaves an animal capable of infecting ground it passes over, until it destroys or runs its course in an attacked animal.

In their investigations, the Bureau authorities completely demonstrated the fact that southern cattle without ticks were incapable of spreading disease; that young ticks hatched from eggs laid by ticks plucked from southern cattle produced the disease when placed on susceptible northern cattle in from thirteen to twenty-one or more days, depending upon the age of the cattle and the temperature of the weather.

They also demonstrated that blood taken from affected cattle produced disease in young cattle, and death in older cattle in from thirteen to twenty-one days, but on one occasion eight days and on another nine days. It has been demonstrated that the appearance of the disease in northern cattle is entirely dependent upon the life-history of the cattle tick. For example: southern cattle passing through stock yards, riding in cars, driven over highways or pasturing, lose the ticks, which usually infect them, upon the ground. These ticks lay eggs beginning in from one to four days, and continuing a week. Incubation begins at once, and continues, depending mainly upon heat and moisture, from three to six weeks. Since the ovipositing is prolonged, the hatching is also prolonged. After a day or two the recently hatched ticks scatter somewhat and crawl upwards on the grass blades, sticks, or whatever is first met with. They are then ready to attach themselves to cattle, from which alone they can get the sustenance necessary to carry them to maturity. They may endure, however, in this condition for a practically indefinite time, three to four months, unless benumbed by the chilling frosts and the low average temperature of the fall months.

The home of these ticks, the country where they are practically perpetually present, unless eradicated by the efforts of farmers or agricultural processes, is coincidental with the area described above as containing cattle which may carry disease to northern cattle. The tick does not seem to be able to stand climatic con-

ditions of winter north of the thirty-seventh parallel, with few exceptions, certainly not north of the thirty-eighth. *Whenever it is found north of its usual habitat, it is because it or its parents have been transported there by cattle in the course of traffic.*

The facts that must be borne in mind when considering any outbreak in the north, and I might add within the so-called infected territory, are that cattle bearing ticks drop them; from these, young ticks emerge usually in about six weeks in warm weather; and that northern cattle usually die in from two to three weeks after they are attacked. While the time of hatching of ticks is delayed by cooler weather of spring or fall, the above epitome is essentially correct. *The time, therefore, between infection of ground and the destruction of cattle is from seven to ten weeks.*

The determination that certain cattle have died of Texas fever, — a disease that can only be communicated by their having been in places infected by cattle brought from the permanently (so-called) infected area, — points out the direction in which one must search for the source of the disease, viz., to cars, stock yards, etc.

By your direction, Mr. Chairman, I have followed up both negative and positive evidence in this connection; indeed, this has been necessary, for only toward the close of the investigation did the positive evidence present itself. Since the diseased cattle were scattered to farms from the Brighton stock yards, when there was no disease in other cattle with which they mingled, it became evident that they must have contracted it before being separated.

On looking back at the date concerning the second carload lot, it will be seen that cattle died *eight* days after they arrived at Brighton; also that one cow died in *nine* days after in the first carload, and three in the third carload within *ten* days after arrival.

A reference to the experiments relating to the time of death from the disease after ticks have been placed upon cattle show it to be thirteen days or more. My own investigations have shown that deaths have occurred in outbreaks as soon as eleven days after exposure; but this is exceptional. In blood inoculation, where blood was transferred from diseased cattle directly to sound, death in one instance alone was unexpectedly produced in eight days; in another, in nine days. As a rule, the time is about the same as for tick inoculations. It is conceivable, therefore, that the disease might develop within ten days from tick inoculations, but hardly probable. Since the disease broke out in five cases in from eight to ten days after reaching the Brighton yards, infection from those yards is practically excluded. In the absence of positive infection by the proof of southern cattle having been placed in those yards, they must be regarded as uninfected.

The evidence regarding the infection of the Connecticut cattle has an important bearing. The first cow died on the eleventh day after leaving West Albany. These were standing in a pen adjacent to the first carload of cattle that went to Massachusetts on the same day. The development of the disease in the Connecticut cattle, which of course never were in the Brighton yards, serves to point to West Albany stock yards as the source of infection. However, as will be seen later, traffic in southern cattle seems to have been so loosely conducted that no yard through which such may have slipped is above suspicion when outbreaks occur in cattle which have passed through it.

In company with Dr. Kelly, I visited Watertown, Jefferson County, New York, and Little Falls, Herkimer County, whence these cattle were procured. We found at Watertown, that, according to Dr. J. R. Bell, United States government inspector at that port, not only had there been no disease of any description among the county farms, but that no cattle of any kind had been shipped into Watertown for any purpose whatever, or into the county, barring Canadian cows which are shipped *via* Cape Vincent en route to eastern points.

On this trip we investigated a rumored case in Oswego County at Vermillion, N. Y., — a case that had been reported to the New York Department of Agriculture. The cow was raised on the place, had never been off from it, nor had other cattle been brought to the place nor into the vicinity. The cow suffered from another disease.

At Little Falls we called upon Mr. William Cotter, of whom nine head of the first carload had been purchased. There had been no disease on his place or on the farms from which he purchased the cattle, nor had Buffalo or Chicago cattle been introduced.

Mr. A. L. Eaton, who lives about three miles from Little Falls, had sold six of the first carload; he is a buyer. He has a large pasture, where cattle from all parts mingle. He has not had, nor heard of, disease in cattle excepting those he sold to Mr. Smith. He had bought Buffalo cattle three months before; but according to Mr. Smith, at least part of these Buffalo cattle which he (Smith) bought died, showing their susceptibility to the disease. They did not infect the pasture, otherwise there would have been trouble before our visit. There were at the time of our visit sixty head of cattle in the pasture.

The disease could not have arisen either in Herkimer or Jefferson counties. There remains the possibility of car infection and yard infection at West Albany stock yards. I believe that infection of the Connecticut cattle at the unloading place in New Milford,

Conn., is practically excluded, for no western cattle are unloaded there, and cattle have since been unloaded there with no danger.

The possibility of car infection must be admitted until the use of each car through the entire season is proven. Since four different local cars were in use, perhaps five, infection must be pretty generally widespread, and car disinfection little practised, if due to this source. While it is my opinion that infection was not due to infected cars in any case, the possibility remains; a search of the uses to which those cars have been put will reveal whether this infection of either car has been possible. (Note: car numbers furnished by United States Bureau of Animal Industry shows no probability of car infection.)

The single cow that died in Albany was said to have been "all around the stock yards." Since she had not been in cars, her infection must have been at the stock yards, for there is no other possible source in Albany to which she had access. Quarantine cattle consigned to slaughter houses are said to be unloaded elsewhere.

A consideration of the facts regarding the treatment of the cattle at the West Albany stock yards, the time at which the disease appeared and the impossibility of their having contracted the disease earlier, forces the conclusion that they were infected at that point.

On August 1 the cattle of cars Nos. 10028, Rome & Watertown, and 22931, New York Central, were received from Herkimer and St. Lawrence counties, N. Y., and put into pens 15 and 16, alley D, respectively. They were forwarded, the first carload to Brighton, Mass., the second to New Milford, Conn., their only point of contact beiñg when they were put into the contiguous pens. Cattle from car No. 10028 began dying in ten days thereafter, and the outbreak continued for ten days; cattle from car No. 22931 began dying in fourteen days, and continued about a week.

On August 8, cattle from car No. 10033, Rome & Watertown, were received from Jefferson County and put into pen 16 D. Some of these died between ten and fifteen days thereafter. On August 15, cattle from car No. 23015 were also received from Jefferson County and put into pen 17 D. Some of these died between twelve and fifteen days thereafter.

Of the eighty-five head in the four carloads put in pens 15, 16 and 17 at this time, forty-five died in from ten to twenty days thereafter, and the bulk of them died about fourteen days after infection.

The data pointing to the infection being in these pens accords

with the experimental evidence. The main difference seems to be that the disease is more virulent and has a quicker course when spread by natural means than artificial, — a condition which is borne out by a study of other outbreaks as well.

On July 25, Mr. Geo. Smith fed and watered a carload of cows *en route* from New York State to Brighton, Mass., at West Albany, in pen 16 D; Mr. A. W. Baggs also fed and watered a carload in pen 15 D, *en route* from New York State to Wilbraham, Mass. I further find, on consulting notes furnished by the management of the West Albany stock yards, that pen 16 D was used on July 11 and 18 by Mr. Smith. It is probable that pens 15 and 17 were also in use; indeed, the superintendent and others told me that it was the custom to open all the pens of alley D between market days, and permit cows to feed in them.

On August 15, a carload (No. 23033, New York Central) of cattle, consisting of twenty cows and three bulls, consigned to New Haven under the name of E. D. Williams, were entered into pen 16 D. Since no report of this stock has been made to Cattle Commissioner Sprague of Connecticut, and inasmuch as it was mixed stock, it is quite likely that the cattle were slaughtered in New Haven. This is the only reasonable explanation of disease not having broken out and being reported in this shipment.

If the cows that went into pens 15 and 16 D on August 1 were infected there, while other cows equally susceptible that went into these pens on July 25 were not, it is apparent that the infection became active at some period between these dates. On this supposition, we may be quite certain that the cattle ticks which were found on the cows in Massachusetts, Connecticut and Albany were hatched out, if in these pens, two or three days prior to August 1. Since these ticks do not hatch out under the most favorable conditions in less than three weeks, and under usual conditions in from five to six weeks, it is evident that the ticks from which they descended must have been dropped in these pens at from three to six weeks earlier. Three weeks prior to August 1 is July 10, and the latest date infection of pens 15 and 16 could have been expected in order to produce the disease which killed the cattle during the middle of August. Six weeks prior to August 1 is June 19, and is within a few days of the earliest date that infection probably occurred; for otherwise the cows put into these pens July 25 should have been infected from the earlier-hatched ticks.

It has been quite impossible to get a concise history of the infection of these yards, yet sufficient has been learned to incline the most sceptical to the belief that the difficulty lies in obtaining exact

proof of method of infection, rather than the fact that they were infected.

At least one possible source of infection has been discovered. On June 19, the books of the stock yard company show that a carload of seventy-eight calves, one dead (car No. 22989, New York Central), *en route* from Buffalo to New York, were stopped off and put into pen 15 D. The way-bill of the railroad company shows that a car No. 23033, with a similar consignment, was stopped off at the yards June 18. This way-bill was marked "quarantined cattle," showing them to have been cattle from the cattle-tick area. These calves were held in Albany until the 24th of June, awaiting a better market. According to the most reliable testimony Dr. Kelly and myself could get, some of these were at least yearlings, and were transferred certainly to pen 17 D. Our notes taken at the time of investigation show this. While I am of the opinion that the same testimony showed that these calves went into pens 15 and 16 D in turn, Dr. Kelly thinks not. However, the fact that the stock yards company received quarantine cattle into alley D, pens 14, 15 and 17, and harbored them about five days, is fully established.

NOTE. — Copy in part of letter from Dr. Kelly to Dr. Curtice: —

OCT. 25, 1897.

Dr. COOPER CURTICE, *Moravia, N. Y.*

DEAR SIR: — I sent you, on Friday evening, a Boophilus Bovis, which was taken by Mr. Rand, in my presence, from neck of a native horse, weighing abont 1,400 pounds. This horse has been allowed to pasture in alley D and the yards adjoining, with the pony (from which the two-weeks-old ticks were taken), together with a number of colts. This accounts for the manner in which the ticks got on the pony. The pony referred to was purchased in Buffalo some time in August, and was shipped direct to West Albany, where it has been kept, and is still here. A portion of the time it has been kept in the barn, allowed to pasture in alley D and yards adjoining, and the balance of the time in the barn where it is at present. I am now satisfied that this pony picked up these ticks in alley D. I intend to look on the colts which pastured there at the time the horse and pony did, and will see if I cannot find more ticks. I do not know as *it has ever been proved* before that ticks would develop upon a horse, but certainly here is a case where they have.

In reference to yards 15 and 16, since we have found that the other carload of calves (No. 22989) were quarantined cattle, explains how these yards were infected. Since receiving the list from Washington, the railroad company corroborates it, and the cars Nos. 23033 and 22989 are correct. No. 22989 contained ninety-six live and two dead calves, as stated before. Both of these cars were unloaded, and the calves were

fed and kept at West Albany, in alley D and yards adjoining (15, 16 and 17).

I think we have now clear proof of how the yards in alley D, 14 to 17, inclusive, were infected. It should certainly be a lesson that in the future more care should be taken in the way that quarantined cattle are handled.

(Signed) WM. HENRY KELLY.

On June 19 there is record of a consignment of eight carloads of Chicago cattle to W. H. Munroe, Brighton, Mass., *via* West Albany. The cars used were Boston Live Stock Express Nos. 53, 89, 81, 51, 67, 21, 39 and 45. The first four were shipped east, according to the Boston & Albany Railroad books, on June 20; the second four, on June 21. The latter four cars at least were unloaded at the West Albany yards. Cattle from this lot were put into pens 3 and 4, alley E, and 15 and 16, alley D.

On June 23 a consignment of thirty-six steers was received at West Albany stock yards, *en route* for Brighton, Mass., W. H. Munroe consignee. These came in cars Boston Live Stock Express Nos. 19 and 64. On the 26th, eighteen head, the rest having been sold in Albany, were reshipped in car Boston Live Stock Express No. 58. These were said to have been put into shed No. 26. The above is from stock yard notes.

The railroad notes give four cars of steers, Boston Live Stock Express Nos. 73, 70, 19 and 64, showing some confusion between the two. These shipments to Munroe were not recorded as quarantine cattle, but comprise, with the Harrington shipment of calves (?), the only lots that Dr. Kelly and myself could find record of up to the present time, October 10, which could possibly have infected the suspected yards.

On June 17, W. H. Munroe, Brighton, Mass., consigned in Burton's stock car No. 55 a carload of quarantine cattle from Chicago to Boston. These were said to have been sold in Buffalo, and not to have reached Boston. The coincidence of the dates of shipment of the eight carloads and this carload suggest the possibility of mixing at Buffalo of the two lots, and the subsequent contamination of pens 15 and 16 by the quarantine cattle. Thorough investigation alone will determine the fact.

The thorough investigation of what has happened to each carload of quarantined cattle that has been shipped through Albany under the supervision of the United States Bureau of Animal Industry has been delayed even to the present time, October 11, on account of the delayed answer from the Bureau in reply to the request of Assistant Commissioner Flanders for the data relating

to such shipments. Dr. Kelly will make the investigation for New York State when the advices are received, and furnish you with a report thereon.

There is no unloading chute or quarantine pen now at West Albany; whatever quarantine cattle are unloaded there must be unloaded into the common stock-yard pens, and either driven directly for slaughter or taken into the pens used by other cattle. There is a tradition commonly entertained by the older stockmen that there was once a separate chute and pens for such cattle, but that these became old and decayed, and were finally pulled down as being of no more use.

The destruction of cattle by a contagious disease contracted in the progress of conveyance from one State to another naturally arouses the question of responsibility in the minds of the losers of those cattle.

The question which confronts your Board is, How may future outbreaks be prevented? This question is one which interests every northern State which is likely to receive southern cattle in the summer time. While the question of legal responsibility may never be taken up or pushed to a conclusion, that of responsibility for taking necessary steps to prevent future outbreaks may readily be arrived at.

The heavy losses in cattle due to Texas fever prior to 1889, and the attitude assumed by States in quarantining against the admission of southern cattle within their boundaries or their passage *en route* to other States, and the accompanying interruption of cattle traffic, led to the quarantine by the United States Department of Agriculture of all cattle south of a stated line, and their assuming oversight of all cattle transported from that area for immediate slaughter until they had been delivered into pens set apart for them at their destination. The line was established on the clinical evidence obtained by earlier investigation, and has been subject to subsequent revisions. The quarantine was found to be of such commercial utility that it has since been annually proclaimed.

The proclamation for the current year is: —

Regulations concerning Cattle Transportation.

U. S. Department of Agriculture, Office of the Secretary,
Washington, D. C., Jan. 27, 1897.

To the Managers and Agents of Railroads and Transportation Companies of the United States, Stockmen and Others.

In accordance with section 7 of the act of Congress, approved May 29, 1884, entitled "An act for the establishment of a Bureau of Animal

Industry, to prevent the exportation of diseased cattle, and to provide means for the suppression and extirpation of pleuro-pneumonia and other contagious diseases among domestic animals," and of the act of Congress which became a law April 24, 1896, making appropriation for the Department of Agriculture for the fiscal year ending June 30, 1897, you are hereby notified that a contagious and infectious disease, known as splenetic or southern fever, exists among cattle in the following-described area: —

All that country lying south, or below, a line beginning at the north-west corner of the State of California; thence east, south and south-easterly along the boundary line of said State of California to the south-eastern corner of said State; thence southerly along the western boundary line of Arizona to the south-west corner of Arizona; thence along the southern boundary lines of Arizona and New Mexico to the south-eastern corner of New Mexico; thence northerly along the eastern boundary of New Mexico to the southern line of the State of Colorado; thence along the southern boundary lines of Colorado and Kansas to the south-western corner of Kansas; thence southerly along the western boundary line of Missouri to the south-western corner of Missouri; thence easterly along the southern boundary line of Missouri to the Mississippi River; thence northerly along the Mississippi River to the northern boundary line of Tennessee at the north-west corner of Lake County; thence easterly along said northern boundary line to the north-east corner of Henry County; thence in a northerly direction along the boundary of the Tennessee River to the north-west corner of Stewart County; thence in an easterly direction along the northern boundary of Tennessee to the south-western corner of Virginia; thence north-easterly along the western boundary line of Virginia to the northernmost point of Virginia; thence southerly along said boundary line to the north-east corner of Virginia, where it joins the south-eastern corner of Maryland at the Atlantic Ocean.

Whenever any State or Territory located above or below said quarantine line, as above designated, shall duly establish a different quarantine line, and obtain the necessary legislation to enforce said last-mentioned line strictly and completely within the boundaries of said State or Territory, and said last above-mentioned line and the measures taken to enforce it are satisfactory to the Secretary of Agriculture, he may, by a special order, temporarily adopt said State or Territorial line.

Said adoption will apply only to that portion of said line specified, and may cease at any time the Secretary may deem it best for the interest involved, and in no instance shall said modification exist longer than the period specified in said special order; and at the expiration of such time said quarantine line shall revert without further order to the line first above described.

Whenever any State or Territory shall establish a quarantine line for above purposes, differently located from the above-described line, and shall obtain by legislation the necessary laws to enforce same completely and strictly, and shall desire a modification of the Federal quarantine line to agree with such State or Territorial line, the proper authorities

of such State or Territory shall forward to the Secretary of Agriculture a true map or description of such line and a copy of the laws for enforcement of same, duly authenticated and certified.

Such States or Territories as now have a line established as last above mentioned can immediately forward certified copies of said line and laws for the enforcement thereof; and, if satisfactory to the Secretary of Agriculture, the same may be adopted at once, and the Federal line so modified.

From the fifteenth day of February to the fifteenth day of November, inclusive, during each year, no cattle are to be transported from said area south or below said Federal quarantine line above described to any portion of the United States above, north, east or west of the above-described line, except by rail for immediate slaughter, and when so transported the following regulations must be observed: —

1. When any cattle in course of transportation from said area are unloaded above, north, east or west of this line, to be fed or watered, the places where said cattle are to be fed or watered shall be set apart, and no other cattle shall be admitted thereto.

2. On unloading said cattle at their points of destination, pens, sufficiently isolated, shall be set apart to receive them, and no other cattle shall be admitted to said pens; and the regulations relating to the movement of cattle from said area, prescribed by the cattle sanitary officers of the State where unloaded, shall be carefully observed. The cars that have carried said stock shall be cleansed and disinfected as soon as possible after unloading and before they are again used to transport, store or shelter animals or merchandise.

3. All cars carrying cattle from said area shall bear placards stating that said cars contain southern cattle, and each of the way-bills of said shipments shall have a note upon its face with a similar statement. Whenever any cattle have come from said area and shall be reshipped from any point at which they have been unloaded to other points of destination, the cars carrying said animals shall bear similar placards with like statements, and the way-bills be so stamped. At whatever point these cattle are unloaded, they must be placed in separate pens, to which no other cattle shall be admitted.

4. The cars and boats used to transport such animals, the chutes, alleyways and pens used during transportation, and at points of destination, shall be disinfected in the following manner: —

(*a*) Remove all litter and manure. This litter and manure may be disinfected by mixing it with lime or saturating it with a five per cent. solution of carbolic acid; or, if not disinfected, it may be stored where no cattle can come into contact with it until after November 15.

(*b*) Wash the cars and the feeding and watering troughs with water until clean.

(*c*) Saturate the walls and floors of the cars, and fencing, troughs and chutes of the pens with a solution made by dissolving four ounces of chloride of lime to each gallon of water; or disinfect the cars with a jet of steam under a pressure of not less than fifty pounds to the square inch.

Cattle from the Republic of Mexico may be admitted into the United States to remain below said Federal quarantine line after inspection, according to law; but said cattle shall not be permitted to cross said quarantine line otherwise than by rail for immediate slaughter, except by special permit from the inspectors of the Bureau of Animal Industry, issued according to the regulations of the said Bureau; and no permit shall be issued except for cattle free from splenetic, or Texas, fever, or from contact therewith during the three months preceding the issuance of said permit, and which have been grazed in a locality free from infection of such fever.

Notice is hereby given that cattle infested with the *Boöphilus bovis*, or southern cattle tick, disseminate the contagion of splenetic, or southern, fever (Texas fever); therefore cattle originating outside of the district described by this order or amendments thereof, and which are infested with the *Boöphilus bovis* ticks, shall be considered as infectious cattle, and shall be subject to the rules and regulations governing the movement of southern cattle.

Stock yards companies receiving such cattle shall place the same in the pens set aside for the use of southern cattle, and transportation companies are required to clean and disinfect all cars and vessels which have contained the same, according to the requirements of this department.

The losses which formerly occurred to the owners of susceptible cattle, both in the interstate and export trade, by the contraction of this disease from exposure in unclean and infected cars and pens, and by means of the manure carried in unclean cars from place to place, became a matter of grave and serious concern to the cattle industry of the United States, until this danger was removed by the inspection of this department. It is absolutely essential, therefore, that this cattle industry should continue to be protected as far as possible by separating the dangerous cattle and by the adoption of efficient methods of disinfection.

Inspectors are instructed to see that disinfection is properly done, and it is expected that transportation and stock yards companies will promptly put into operation the above methods.

All prior orders conflicting herewith are hereby revoked.

J. STERLING MORTON,
Secretary.

The restriction placed upon traffic in cattle for feeding purposes and the comparatively complete separation of infected cattle from the others in the large stock yards of this country, cut down losses from this source to a minimum, yet outbreaks resulting in a total of thousands of dollars' loss have since annually occurred, due to evasions of the law along the quarantine line and in unprotected places.

In the present instance the loss was brought about *by the unloading of quarantine cattle into pens used by other cattle and by admitting other cattle thereto*, in direct violation of Regulation No. 2.

This, perhaps, was unintentional by the owner of the cattle, who merely wished to profit by an expected rise in the New York market; but the breaking of the regulations exists. It certainly was overlooked by the railroad men and ignored by the stock yard men.

I find that most carloads of cattle are shipped through from Buffalo to Boston, or New York. This run requires more than twenty-eight hours; it being claimed that cattle are often twenty-two hours in reaching Albany. It is rumored about the stock yards there that little attention is paid to the fact whether cattle are twenty-eight hours *en route* or forty-eight, further than it is for the profit of the stockman to care for his cattle.

Sections of the Revised Statutes referring to the Transportation of Animals.

SECT. 4386. No railroad company within the United States whose road forms any part of a line of road over which cattle, sheep, swine or other animals are conveyed from one State to another, or the owners or masters of steam, sailing, or other vessels carrying or transporting cattle, sheep, swine, or other animals from one State to another, shall confine the same in cars, boats, or vessels of any description *for a longer period than twenty-eight consecutive hours*, without unloading the same for rest, water and feeding, for a *period of at least five consecutive hours*, unless prevented from unloading by storm or other accidental causes. In estimating such confinement the time during which the animals have been confined without such rest on connecting roads from which they are received shall be included, it being the intent of this section to prohibit their continuous confinement beyond the period of twenty-eight hours, except upon contingencies hereinbefore stated.

SECT. 4387. Animals so unloaded shall be properly fed and watered during such rest by the owner or person having the custody thereof, or in case of his default in so doing, then by the railroad company or owners or masters of boats or vessels transporting the same, at the expense of the owner or person in custody thereof; and such company, owners, or masters shall in such case have a lien upon such animals for food, care, and custody furnished, and shall not be liable for any detention of such animals.

SECT. 4388. Any company, owner, or custodian of such animals who knowingly and willingly fails to comply with the provisions of the two preceding sections, shall, for every such failure, be liable for and forfeit and pay a penalty of not less than one hundred nor more than five hundred dollars. But when animals are carried in cars, boats, or other vessels in which they can and do have proper food, water, space, and opportunity to rest, the provisions in regard to their being unloaded shall not apply.

SECT. 4389. The penalty created by the preceding section shall be recovered by civil action in the name of the United States, in the circuit or district court of the United States, holden within the district where the violation may have been committed, or the person or corporation

resides or carries on its business; and it shall be the duty of all United States marshals, their deputies and subordinates, to prosecute all violations which come to their notice or knowledge

If the humane federal law requiring cattle to be unloaded at the end of each twenty-eight hours' confinement for feeding and watering is to be carried out, then many quarantine cattle must be unloaded at Albany. In this connection the shipment of quarantine cattle for slaughter to Albany and other points in New York and Massachusetts, where no federal office is located, must be considered. These cattle, of which in different years there are varying numbers, are delivered at any station and then driven to slaughter houses without supervision. Many cars are taken to other points, to be used without, so far as can be learned, any attempt or pretence at disinfection. These conditions continually expose the native cattle of these States, and, I may add, of other States, to attacks of Texas fever. The responsibility for the spread of disease by carloads of quarantine cattle which go to places where there are no pens set apart to receive them, and no provisions to adequately disinfect cars according to the regulations, or for attending to the enforcement of these regulations, lies with the officers of the Bureau of Animal Industry, who are charged with the enforcement of the law. The States are not responsible for the spread of disease until the cattle leave those places set apart for them to go to slaughter.

The Bureau authorities are aware that, when cattle are released from Chicago or Buffalo, consigned to Brighton or New York, or to a place in Massachusetts where there is no quarantine yard, these cattle may be unloaded at Albany, and that most of them in accordance with the twenty-eight-hour unloading law must be unloaded there, or they will be unloaded at some other place where there are no quarantine regulations or pretence at any. They have hitherto read their instructions as concerning the larger stock yards for the protection of the foreign and domestic cattle trade, and trusted to the exclusion of quarantine cattle for pasturage purposes to prevent disease in our own country. They have regarded their duties as ended when cattle were properly entered and released from the yards where their agents are stationed. They have overlooked the fact that cattle have been released to points where conclusive evidence was easily obtainable that their laws were not, and could not be, complied with as regards the released shipments. They have apparently made no effort to ascertain the fact whether quarantine cattle were being handled properly at such an important point as Albany, where quarantine

cattle are received *en route* and for immediate slaughter, and native cattle received and distributed to adjoining States. They have made no effort, that can be ascertained, to enforce the disinfection of cattle cars used in carrying quarantine cattle when these are unloaded at points where there are no officers.

The oversight of quarantine cattle until they are put into pens set apart to receive them cannot be relaxed on account of State laws permitting otherwise; for interstate relations are such that, as in the present case, an outbreak may occur in other States, due to relaxed precautions.

Suppose, in the present case, quarantine cattle had been unloaded into either or each of the cattle pens at Watertown, Norwood and Herkimer, N. Y., the native cattle would have been exposed in these places in New York State, and have died in Massachusetts and Connecticut. It cannot be said of any cattle pens in the United States that they will not be used for cattle in interstate traffic. They are built for cattle traffic, and cattle are shipped to and fro with no thought of State lines.

The duties of the federal authorities should be terminated only after they have delivered the cattle into pens set apart *en route*, or at their destination, and they have overseen the disinfection of the cars. If they cannot attend to this, they should refuse to release quarantine cattle destined to unprotected points. Having fulfilled their obligations in the delivery of quarantine cattle, they should then notify the State authorities that such are delivered, and turn their care over to them. Then they will have freed themselves from the responsibility of having delivered disease-breeding, proscribed cattle into an unsuspecting community; and the State may make suitable regulations for their handling, should they desire to receive them.

The conditions followed at present would be paralleled if United States authorities should convey with all possible care a carload of yellow-fever patients to some more or less important communities in our States, and quietly infect places where other people would contract the disease. The practice is indefensible and inexcusable. The wording of the United States agricultural regulations, quoted above, shows that they think it is.

There are other unavoidable conditions in railroad traffic that have heretofore spread Texas fever, and may again. Accidents delay cattle trains; sometimes cattle cars become broken *en route*, and the cattle either released violently or compulsorily. When such happens, places where this occurs should be quarantined by the State after notification by federal officers.

Another condition prevailing in other States through which the

quarantine line is drawn has a remote bearing upon the cattle traffic in Massachusetts. Prior to 1896 the shipment of cattle from infected areas in Virginia to any point outside was comparatively easy, both by cars and by driving the cattle across the line on foot, and then shipping them, — each of which was against the law. Since then, however, a more stringent State law, better enforced, has quite stopped such shipments. During the present year, however, quarantine restrictions put in force by the State of Illinois against Tennessee and Arkansas on account of disease transported from those localities show the incomplete enforcement of the quarantine line in those States. This condition of affairs along the line will more or less menace the cattle industry until the States enter into hearty co-operation in enforcing State and federal laws. At any time under such conditions the State of Massachusetts might be invaded, but on account of the nature of traffic at rare intervals. The possibility of infection from such source of some of the eight carloads of cattle bought at Chicago by W. H. Munroe, and stopped *en route* to Brighton at West Albany, is suggested.

In thus laying the responsibility for the spread of Texas fever at the door of the Bureau of Animal Industry, I do not intend in any way to exonerate railroad officials, stock yard companies or cattle men who knowingly or unwittingly override the law, but to draw attention to the first source, where the law may be more thoroughly carried out, and thus prevent infractions by others concerned. Those interested in cattle traffic in quarantined animals cannot be blamed too harshly for violations, when officials permit cattle to be released to points under conditions in which the law must be violated.

The laws of Massachusetts do not seem to have been violated in the recent outbreak by the introduction into the State of any disease-bearing cattle. The diseased cows introduced died. But one recovered animal was found to bear a single tick, and this at so late a date that the young could not possibly hatch out for infection of other cattle.

An examination of the method of handling cattle at the Brighton yards, the unloading of all quarantine cattle at the Brighton abattoir and the complete absence of data showing infection of these yards indicate that no infection has been in these yards this year. The quarantine imposed by the United States authorities may have been justified so long as suspicion attached to these yards in the course of investigation, but no longer. Unless it can be shown that the United States authorities had reason to suspect that infected cattle had passed through these yards in June, or the

first week in July, the quarantine was unjust, for the history of the outbreak pointed to an infection of the cattle before they passed through these yards. The only protection the State of Massachusetts has against future recurrence of losses from this disease is the insistence upon federal authorities carrying out the regulations of the United States Department of Agriculture in other States and in Massachusetts, or on the entire exclusion of such cattle from Massachusetts. The traffic for the present year is so inconsiderable that it may well be stopped, in view of the loss to the State that it might produce.

The laws of Massachusetts bearing on this point are as follows: —

SECT. 53. When animals are transported within this state from localities beyond its boundary lines, which localities the board of cattle commissioners deem to be infected, such animals may be seized and quarantined by the commissioners at the expense of the owners or consignees thereof, so long as the public safety may require; and if, in their judgment, it is necessary to secure that safety, they may cause such animals to be killed without appraisal or payment for the same

SECT. 54. No Texan, Mexican, Cherokee, Indian or other cattle, which the cattle commissioners decide may spread contagious disease, shall be driven on the streets of any city, town or village, or on any road in this Commonwealth, nor shall they be driven outside the stock yards connected with any railway in this Commonwealth contrary to any order of the board of cattle commissioners.

SECT. 55. In all stock yards within this Commonwealth said Texan, Mexican, Cherokee, Indian or other cattle, which the cattle commissioners decide may spread contagious disease, shall be kept in different pens from those in which other cattle are kept

SECT. 56. Any person or persons violating any of the provisions of the two preceding sections shall be punished by a fine of not less than twenty nor more than one hundred dollars.

SECT. 37. Contagious diseases under the provisions of this act shall include glanders, farcy, contagious pleuro-pneumonia, tuberculosis, Texas fever, foot-and-mouth disease, rinderpest, hog cholera and rabies.

In the recent outbreak the action of the Cattle Commissioners of Massachusetts and Connecticut in cautioning buyers from bringing their cattle through the West Albany stock yards, or from New York, until the source of disease was located, was all the protection these States had. Though necessarily tardily taken, it probably prevented some loss. The fact that but few cattle passed through the infected yards prevented more loss. The final quarantine of the suspected pens by the New York authorities did not occur until the 5th of October, for the reason that they did not

wish to take action until the fact was proven that the cows did become infected in the suspected pens. In yards transacting any considerable business such delay would be productive of great loss.

The federal authorities have depended upon the New York State officials for an investigation and action, and have not investigated the outbreak outside of the Brighton yards. The tardy action of States in investigating such outbreaks should not be awaited for by the federal officers when interstate traffic is involved, and federal laws, over which they alone have supervision, have been violated. Had it not been for the investigation ordered by your own State, the source of infection would not have been definitely decided; each State involved would have believed the other at fault, and no relief against future outbreaks been proposed.

Résumé.

1. The outbreak of disease which destroyed at least thirty-five head out of fifty-eight cows transported from New York State to eastern Massachusetts was due to Texas fever, contracted in the stock yards at West Albany, New York.

2. The infection of the West Albany stock yards was due to the illegal unloading and detention of quarantine cattle in those yards, and presumably to a carload (or two) of quarantined young stock shipped from Chicago to New York, and detained about five days in said yards.

3. Future outbreaks may be prevented by the complete enforcement of United States laws by officers of the United States Bureau of Animal Industry, and the notification of the State Cattle Commissioners concerning the unloading of quarantine cattle into pens set apart for them by those officers.

4. The present State law relating to the unloading of cattle which may spread Texas fever seems adequate for all purposes, and, if carried out, will prevent Texas fever spreading from cattle delivered into "places set apart."

5. The investigation undertaken by the Cattle Commissioners will have been justified when adequate steps are taken to prevent future outbreaks; then Texas fever, as a disease of northern cattle, will become an historical reminiscence.

COOPER CURTICE.

The existence of Texas fever in Massachusetts this summer was first called to the attention of the Board of Cattle Commissioners by Commissioner Dennen, who had three cows, bought in Brighton, — two from the carload arriving

August 2, one from the carload arriving August 9, — which sickened and died.

Specimens from the spleens and kidneys of two of these cows were examined by Dr. Langdon Frothingham, and the organism of Texas fever found to be present; the diagnosis was confirmed by Dr. Theobold Smith.

As soon as it became clear to the Cattle Commission that it had an outbreak of Texas fever to deal with, the following notice was sent to the principal shippers of cattle from New York State into Massachusetts: —

COMMONWEALTH OF MASSACHUSETTS.

BOARD OF CATTLE COMMISSIONERS,
COMMONWEALTH BUILDING, BOSTON, Aug. 27, 1897.

DEAR SIR: — It having come to the notice of the Massachusetts Cattle Commission that cows brought from certain localities in New York State, and sold at Union Market, Watertown, and the stock yards, Brighton, have in some instances died of Texas cattle fever after being taken away by purchasers, we would notify you of the above facts, and warn you against bringing in any cattle from New York State until the 1st of October, except beef cattle to be killed at the slaughter houses.

Yours truly, AUSTIN PETERS,
Chairman.

The leading agricultural papers were also requested to make the matter public, which they did at once, and intending purchasers were informed that there was a risk in buying New York State cows. The result was that the importation of cattle from New York State into Massachusetts was practically stopped for the time being, and it became pretty certain that the trouble was traceable to the stock yards at West Albany; such cattle as were shipped into Massachusetts from New York State were sent around a northern route by way of the Vermont Central Railroad, until the weather became so cold that there was no more danger to cattle coming through the West Albany stock yards.

Owing to these precautions, the loss of animals was confined to the three carloads mentioned in Dr. Curtice's report.

From Dr. Cooper Curtice's report it may be seen that the point where the New York State cows became infected was

at West Albany, and before it was even decided to employ him to investigate the outbreak it is clear that the Massachusetts Cattle Commissioners were right in being of the opinion that the disease was not contracted in this State; however, upon learning that there was an outbreak of Texas fever in Massachusetts, the chief of the Bureau of Animal Industry at Washington telegraphed to Dr. D. D. Lee at Boston, the veterinarian having charge of the Bureau's work at this port, under date of September 2, quarantining the Brighton yards against export cattle.

Later, when it became evident that the animals that afterward died had only been in pens 11 and 13 on Texas Street, and pens 33 and 35, known as J. S. Henry's pens, on Front Street, the quarantine was changed on September 23 to include only these four pens, until further notice. This quarantine upon the four pens has not been officially removed, but expired on November 15 by the time limit in the proclamation of the Secretary of Agriculture defining the infected area, extending from February 15 to November 15.

By advice of Dr. Curtice after he commenced his investigation of the outbreak, four cows were bought and kept in pens 11 and 13, to determine whether or not they were infected.

There was no necessity for experimenting with pens 33 and 35 on Front Street, as J. S. Henry sells cattle from other points that pass through these pens every week, and there is no record of any creatures dying of Texas fever this season that passed through his pens except from the three carloads that came from New York State through the West Albany stock yards last August.

The New York State cattle were first unloaded into pens 11 and 13, Texas Street, and in this respect were handled differently from any other cattle consigned to Mr. Henry; and as steers for slaughter also pass through pens 11 and 13, there was more reason for considering these pens a possible source of danger.

After buying these cows, two were kept in pen 11 and two in pen 13 from September 28 until October 15, when they were removed to a shed on the same street that had not

been used for cattle. Here they were kept for eighteen days, their temperature being taken daily, as follows: —

DATE.	No. 1. Red Cow, White on Udder.	No. 2. Red Cow, Balls on Horns.	No. 3. Black and White Cow, Middle of Tail White.	No. 4. Black and White Cow, Half of Tail White.
	Degrees.	Degrees.	Degrees.	Degrees.
October 15, . .	102	$102\frac{4}{5}$	$102\frac{1}{5}$	$102\frac{2}{5}$
16, . .	101	$101\frac{3}{5}$	$101\frac{2}{5}$	$101\frac{2}{5}$
17, . .	$101\frac{2}{5}$	$101\frac{4}{5}$	$101\frac{4}{5}$	102
18, . .	101	$100\frac{4}{5}$	101	102
19, . .	101	101	$101\frac{3}{5}$	$101\frac{3}{5}$
20, . .	101	$100\frac{3}{5}$	$101\frac{1}{5}$	101
21, . .	$100\frac{4}{5}$	$100\frac{2}{5}$	$101\frac{2}{5}$	101
22, . .	$100\frac{2}{5}$	$100\frac{2}{5}$	101	$100\frac{3}{5}$
23, . .	$100\frac{4}{5}$	$99\frac{4}{5}$	$100\frac{2}{5}$	$100\frac{2}{5}$
24, . .	101	$100\frac{1}{5}$	$100\frac{3}{5}$	$100\frac{4}{5}$
25, . .	$101\frac{3}{5}$	$101\frac{1}{5}$	101	$100\frac{3}{5}$
26, . .	$99\frac{4}{5}$	$100\frac{2}{5}$	$100\frac{3}{5}$	102
27, . .	$101\frac{3}{5}$	$100\frac{1}{5}$	101	$101\frac{1}{5}$
28, . .	$101\frac{4}{5}$	$100\frac{3}{5}$	$99\frac{4}{5}$	101
29, . .	101	$100\frac{2}{5}$	$101\frac{1}{5}$	$100\frac{2}{5}$
30, . .	$101\frac{2}{5}$	$100\frac{1}{5}$	100	101
31, . .	$101\frac{1}{5}$	101	$100\frac{2}{5}$	$101\frac{2}{5}$
November 1, . .	101	$101\frac{1}{5}$	101	$100\frac{4}{5}$

At the end of this time the cows were sold, having remained in apparently perfect health; and during the latter half of this period, when the temperatures were taken daily, it can be seen by the above table that these remained normal.

To be still further positive that there has been no infection from the Texas fever organism, Dr. Langdon Frothingham,

a few days before the animals were sold, made cover-glass preparations of their blood, and under date of November 4 reports that he was unable to find any of these organisms in their blood.

It is therefore clear that the source of infection was at the West Albany stock yards. These stock yards became infected because there is no provision for furnishing separate chutes and pens for quarantine cattle, as required by the rules and regulations of the Bureau of Animal Industry; and there is no agent of the Bureau of Animal Industry there to see that these rules and regulations are enforced.

Notwithstanding the fact that suspicion pointed much more strongly to the West Albany stock yards as the infected area, as will be seen from the information gathered by the Massachusetts Cattle Commission, yet for some reason the Bureau of Animal Industry chose to place the odium on the stock yards at Brighton, ignoring the West Albany stock yards, if a quotation from a letter of Dr. Cooper Curtice is correct. He writes, under date of December 8, as follows: —

The only step that the Bureau took regarding the outbreak was to quarantine the Brighton yards. Up to October 14, or since, for that matter, the Bureau took no measures to ascertain where the disease was disseminated in this State (New York State), other than to call it to the attention of the New York Commissioner of Agriculture, about the middle of September, and, I believe, ask him to investigate. No quarantine of those West Albany yards was attempted until after frosts began, — early in October; then the assistant New York commissioner sent Dr. Kelly out there, to tell them that, if they continued to admit cattle to alley D and its pens, he would quarantine the whole yards.

While not a legal procedure, it perhaps accomplished its purpose. The advice of your commission to Massachusetts buyers accomplished more.

The whole matter at West Albany was handled in a very unscientific and illegal manner by both the State and the Bureau. In the first place, the yard should have been quarantined by the Bureau at the same time as the Brighton yards. In the second place, the State authorities should have quarantined on suspicion. The commissioner of New York State was, however, partially excusable, if not wholly, from the fact that the Bureau had already thrown the fault upon the Brighton yards by their act of

quarantine without further action in regard to other places, as West Albany.

Moreover, the State law is poorly drawn up, and requires such publication to be made that the department is unwilling to take steps unless the fact of infection of a given place is established. This procedure may do in some kinds of work, but not in contagious diseases. The United States Bureau of Animal Industry may take steps to prevent recurrences after Feb. 15, 1898, when a new proclamation will go into effect. They may have felt that further quarantine after the middle of October (by which time the commissioner of the New York State Department of Agriculture had taken his steps) was unnecessary. For some reason I have yet to learn of any case prosecuted by the Bureau of Animal Industry against carriers for violation of the quarantine law.

While the losses to cattle owners in Massachusetts and Connecticut were not very heavy, yet in many instances they were incurred by farmers who could ill afford to bear them; beside which, the quarantine on the Brighton stock yards caused some loss and inconvenience to the Boston & Albany Railroad Company.

It is to be hoped that such an occurrence may not be permitted to take place another season, by requiring the West Albany Stock Yard Company to fit its pens to fulfil the requirements of the Bureau of Animal Industry, and by the Bureau having an agent stationed at this important point.

In fact, Dr. D. E. Salmon, chief of the United States Bureau of Animal Industry, writes, under date of November 2, to the Massachusetts Cattle Commission, in part as follows: —

I recognize the fact that Albany is an important point to guard, and have intended to have some one stationed there next season, if possible.

Actinomycosis.

During the year a number of cases of actinomycosis, or lumpy jaw, have occurred among the cattle of the State. This disease is caused by a fungus belonging to the mould family. These fungi are called actinomyces because of their star-shaped appearance under the microscope, and the disease is known as actinomycosis. So far as is known, it does not seem to spread to any extent from one animal to another,

but the fungus is thought to be on the grain or straw, and it is from this source that the affected animal is generally thought to acquire it.

Most commonly the primary seat of the disease is in the jaw, starting in the alveolus of a tooth. The actinomyces frequently find lodgement in the cavities caused by the shedding of the temporary or milk teeth before the permanent teeth make their appearance. In time a large bunch may develop on the face or jaw, and it was because of the nature of the changes set up in the bone that the disease got its former name of Osteo Sarcoma.

After the breaking down of the enlargement, it is possible that an animal may swallow some of the discharge containing the little yellow granules or fungous growths, and in this way secondary infection may take place. The actinomyces may also be absorbed or find lodgement in other organs of the body. For example, it seems to be possible for the fungous growth to gain an entrance at the opening of the milk duct and find lodgement in the udder. Three cases of what appear to be infection in this way have come under the observation of one of the members of the Board.

The first occurred some years ago, in New Hampshire, under the following circumstances: a heifer was noticed to be suffering from the form of actinomycosis known as "lump-jaw;" this was discharging freely, and at this time she was kept in a box stall in the farm hospital; she was finally destroyed. Shortly afterwards a sow with her litter of pigs was placed in this box, and before her pigs were weaned an enlargement began to develop on the left hind portion of the udder. It gradually grew larger, and finally broke and discharged; and because of this, the pigs were weaned and she was destroyed. The post-mortem examination showed no trace of disease except in this portion of the udder, and microscopical examination showed a beautiful specimen of the ray fungus, or actinomyces. The disease in this case was only present in the udder, the fungus probably finding its entrance through the milk duct, the active condition of this organ aiding its development.

The second case occurred in a Lawrence cow; it was quarantined under suspicion of having tuberculosis of the

udder, which was hard and nodulated to the touch. The cow was tested and condemned, and on autopsy was shown to have tuberculosis of the lung and bronchial gland; cultures from this gland were later used by Prof. Theobold Smith in some experiments with tuberculosis. The udder proved to be infiltrated with small nodules with yellow centres, which proved later to be actinomycosis.

The third case occurred at Amesbury, and was very similar to the second, the cow being condemned on physical examination because of the condition of the udder. The cow was free from disease except in this organ, and on section it was found to be studded with small minute nodules with yellow centres, not so well marked, however, as in the second case.

In both these cases, on a superficial cursory examination, this condition might easily have been mistaken for tuberculosis; but on closer inspection it was noticed that the yellowish centres were imbedded in a well-marked band of fibroid tissue. In tuberculosis small-celled proliferation with a tendency to caseation is more marked; while in actinomycosis there is usually more of a tendency to circumscribed fibrous changes, with sometimes a honeycombed structure containing small yellowish granular masses, which may often be squeezed out by the thumb nail.

In all three of these cases the udder seemed to be the initial seat of the disease, the milk duct being the possible source of infection.

Actinomycosis is by no means a typical contagious disease, in that it is not usually conveyed from one animal to another; but an animal with actinomycosis of the udder is by no means a fit animal for dairy purposes, and neither should an animal with generalized actinomycosis be passed as fit for beef.

Glanders.

During the past year 485 horses have been reported to the Board of Cattle Commissioners as suspected of being affected with glanders, or farcy. At the time of compiling this report, December 20, 402 had been killed, 81 had been examined and released and 2 were still in quarantine and under observation.

The following list gives the cases reported from each city and town: —

Glanders reported in 1897.

Cases in: —		Cases in: —	
Amesbury,	1	Merrimac,	1
Andover,	1	Melrose,	7
Arlington,	2	Millbury,	5
Auburn,	2	Milford,	1
Belchertown,	1	Millis,	1
Bellingham,	1	Milton,	1
Boston,	144	Montague,	2
Brimfield,	1	Natick,	1
Brockton,	1	Needham,	1
Cambridge,	29	New Bedford,	3
Canton,	1	Newbury,	1
Charlemont,	1	Newton,	2
Chelmsford,	2	Paxton,	1
Chelsea,	1	Plymouth,	1
Chicopee,	3	Quincy,	11
Clinton,	1	Randolph,	2
Concord,	1	Raynham,	2
Conway,	1	Revere,	1
Danvers,	3	Rockland,	1
Dartmouth,	1	Royalston,	1
Dedham,	1	Somerville,	22
Dighton,	1	Southborough,	1
Easthampton,	1	Springfield,	5
Easton,	2	Stoneham,	2
Everett,	6	Sutton,	1
Fall River,	16	Taunton,	1
Fitchburg,	3	Upton,	2
Foxborough,	3	Walpole,	1
Framingham,	1	Waltham,	2
Grafton,	8	Ware,	1
Groveland,	1	Wayland,	1
Haverhill,	2	Wellesley,	1
Hingham,	4	Westborough,	3
Holyoke,	4	Westfield,	8
Hopedale,	1	West Newbury,	1
Hudson,	1	Weymouth,	1
Lanesborough,	1	Winchester,	2
Lawrence,	5	Winthrop,	1
Leicester,	1	Woburn,	10
Lynn,	19	Worcester,	84
Malden,	3		
Medfield,	4	Total,	485
Medford,	3		

These figures show an increase of cases reported as diseased or suspicious over 1896 of 101, or of actual cases killed of 61. In last year's report it was said that there was an increase in 1896 over the cases in 1895, and this was attributed in part or whole to a better understanding of the law requiring all persons to report suspected cases to local boards of health, and requiring these boards in turn to report to the Board of Cattle Commissioners. But without any better understanding of the law the number of animals reported this year is much greater than last, and by no means represents all the cases that occur, as many horses are killed by owners who do not wish to have it known that the disease exists in their stables, and therefore they do not report it to the local board of health; and in some instances doubtless local boards of health are remiss in reporting cases to the Board of Cattle Commissioners if a horse is killed with the consent of the owner.

There is no doubt concerning the increase of glanders, and this being the case, it must be considered by what means this malady extends itself.

Glanders and farcy are one and the same disease, and it has long been acknowledged that it spreads by means of a germ which may be conveyed from horse to horse by one animal coming in immediate contact with another, by the virus being conveyed from one horse to another by means of curry-combs, brushes, harness and the like, by a healthy horse occupying a stall used by a diseased one, and in similar ways. But to account for its marked and in some ways mysterious increase the past two or three years, there must be another factor besides horses rubbing noses on the street, infected stables, and unprincipled traders in old, worn-out horses; and this factor must be the public watering troughs in our cities and towns; this was the opinion of the Board, as given in its report of two years ago, again last year and reiterated this year.

The reported cases of glanders were, in 1894, 230; in 1895, 250; in 1896, 384; and in 1897, 485; that is, the cases reported have more than doubled in the past three years, and it is probable that some of this increase is due to the public watering troughs.

In substantiation of the fact that it is possible that glanders can be conveyed into the horse's system by means of drinking water containing the glanders bacilli, it is only necessary to refer to a brief report of some experiments carried on by Mon'r Edward Nocard of Alfort, France, as given in the "American Veterinary Review" for September, by Dr. A. Liautard. For these experiments twelve cavalry horses were furnished by the Secretary of War, and placed at M. Nocard's disposal at Alfort. They were first tested with mallein, to be sure that they were free from glanders, and none reacted. Nov. 30, 1896, all of these horses were given water from a pail, each one receiving a certain well-measured quantity of culture of the glanders bacilli. A few days after, varying from four to eight days, there was noticeable a great oscillation in the temperature, indicating a febrile condition. After the eighth day, in some of them enlarged lymphatic glands were noticed, which later assumed the character of the glands noticed in glandered horses. Dec. 15, 1896, they were all tested with mallein, and all reacted. Jan. 15, 1897, all were again tested, and all reacted, although not all to the same extent as at the first test. January 21, three showed so much evidence of disease that they were destroyed.

The others were kept for further experiment, Professor Nocard wishing to see if glanders could be cured by mallein. By May there were six horses that failed to react to mallein, and in July four of these were killed; and although lesions of glanders were found, yet when these lesions were inoculated into donkeys and guinea-pigs they failed to produce disease; in other words, these horses were cured by successive injections of mallein.

These experiments are interesting, because they show that slight, undeveloped cases of glanders can be cured by repeated injections of mallein; but this does not have much to do with the question of glanders as considered here, because the wisdom of attempting to treat cases of glanders as they are reported to this Board is very questionable, and the better course seems to be to have such animals destroyed, as is at present done.

The chief interest lies in the fact that twelve horses, or

one hundred per cent. of those experimented with, could contract glanders through the alimentary canal, when the bacilli were in the water; hence proving the possibility of contaminated drinking water being a potent source of danger, — a fact that has hitherto been disputed by many able authorities. Therefore, in a locality where glanders is prevalent, the public watering troughs should have the water shut off from them; or, if these misplaced charities will not be abandoned, horse owners should on no account allow their horses to drink from them, and should forbid their teamsters to water horses at them, as well. If horses have such long hours as to need water before returning home, the teamster should be made to carry a pail, and draw water from a faucet for his horses.

If a practical demonstration is wanted of the utility of abandoning public water troughs, the history of glanders at Worcester and its vicinity the last two years will serve as an illustration. During 1896 one hundred cases of glanders were reported from Worcester; in 1897 there seemed to be no prospect of a diminution; finally, in April, it increased to such an extent that seventeen cases were reported during the month. This led to a conference between the chairman of the Cattle Commission, Mr. Herrick, Mr. Coffey, agent of the Worcester Board of Health, and the water registrar of Worcester, with the result that it was decided to close the public water troughs from May 8 to July 1. In addition, Mr. Herrick has kept the auction rooms of that city under constant surveillance, having any glandered horse found at these places killed. The result has been a falling off in the number of cases to eighty-four for the year, a marked decrease being noticed soon after having the watering troughs closed, as may be seen by the following table. Many of the cases reported as Worcester animals were horses brought in from adjoining towns by unscrupulous persons, to be sold at the Worcester auction rooms: —

Cases of Glanders in Worcester, Dec. 20, 1896, to Dec. 20, 1897.

Date.	Condemned.	Released.	Date.	Condemned	Released.
December, 1896, after 20th.	1	1	August, . . .	2	1
January, 1897, . .	5	1	September, . .	6	1
February, . . .	8	1	October, . . .	4	3
March, . . .	4	1*	November, . .	3	1
April, ...	17	-	December, to 20th, .	2	-
May, ...	10	1	Total of each, .	73	11
June, ...	6	-	Total quarantined,	84	
July, ...	5	-			

* Released in May, killed in October.

Total for August, September and October, 12, or 20 per cent.

It can be seen that after watering troughs were closed there was a marked falling off, and that during the dry months there was less than in April and May.

In contrast to the above table, the cases occurring in Boston, Cambridge, Somerville and Quincy, four neighboring cities, where glanders has been especially prevalent the last year, will show how it increases when horses drink the most, and just afterward, when nothing has been done to stop its spread by closing the public watering troughs (Cambridge closed a trough at East Cambridge, September 1, for about two weeks).

Date.	Boston.		Cambridge.		Somerville.		Quincy.	
	Condemned.	Released.	Condemned.	Released.	Condemned.	Released.	Condemned.	Released.
December, 1896, after 20th.	2	-	2	-	-	-	-	-
January, 1897, . .	10	-	-	-	-	-	-	-
February, . . .	9	-	-	-	1	-	1	-

DATE.	BOSTON.		CAMBRIDGE.		SOMERVILLE.		QUINCY.	
	Con-demned.	Released.	Con-demned.	Released.	Con-demned.	Released.	Con-demned.	Released.
March, ...	7	–	–	–	1	–	–	–
April,			3	–	2	2	–	–
May, ...	18	1	–	–	–	–	–	–
June,			2	–	1	–	1	–
July, ...	19	–	–	–	1	–	1	–
August, . . .	14	–	10	–	7	3	2	–
September, . . .	21	–	3	2	1	–	3	–
October, . . .	18	–	3	–	2	1	2	1
November, . . .	14	–	2	–	–	–	–	–
December, to 20th, .	11	–	2	–	–	–	–	–
	143	1	27	2	16	6	10	1
Totals, . . .	144		29		22		11	

Grand total, ... 206
Total for August, September and October, 93, or 45 per cent.

It will be seen by the two tables that during August, September and October, at Worcester, only twenty per cent. of the cases of the year occurred; while in Boston, Cambridge, Somerville and Quincy, forty-five per cent. of the cases of the year occurred during these months.

If the increase in the amount of glanders be considered from the localities where it exists, it will be found that it is largely, in fact almost wholly, confined to twenty-eight cities and towns, with Boston as a centre, and the other towns covering a territory that is continuous between them and Boston; and that in many, if not all, there are express men, teamsters and others whose teams pass almost daily to Boston and return, and who water their horses at infected watering troughs on the way, or infect the troughs with glandered animals of their own.

The following table shows that, outside of Boston and twenty-seven adjoining cities and towns, only eighteen more cases of glanders were reported in 1897 than in 1896, while within this comparatively small area there were eighty-three more cases reported than in 1896.

	1896.	1897.		1896.	1897.
Boston, . . .	123	144	Newton, . .	5	2
Cambridge, . .	13	29	Needham, . .	5	1
Somerville, . .	9	22	Dedham, . .	5	1
Everett, . . .	2	6	Hyde Park, . .	2	–
Chelsea, . . .	4	1	Milton, . . .	–	1
Revere, . . .	–	1	Quincy, . . .	3	11
Malden, . . .	6	3	Weymouth, . .	–	1
Saugus, . . .	2	–	Randolph, . .	1	2
Lynn, . . .	3	19	Rockland, . .	–	1
Melrose, . . .	–	7	Hingham, . .	–	4
Stoneham, . .	3	2	Cohasset, . .	1	–
Woburn, . . .	–	10	Scituate,. . .	1	–
Winchester, . .	1	2	Total for Boston and 27 adjoining towns, . .	192	275
Medford, . . .	1	3			192
Arlington, . .	1	2	Increase of 1897 over 1896, . .		83
Watertown, . .	1	–			

Total for whole State, 1896, ...	384
Less, ...	192
Number of cases outside Boston and 27 adjoining towns in 1896,	192

Total for whole State, 1897, ...	485
Less number in Boston and 27 adjoining towns, ...	275
Number of cases outside Boston and 27 adjoining towns in 1897,	210

In 1897, ...	210
In 1896, ...	192
Increase for year outside these cities and towns, ...	18

Per cent. of glanders in Boston and 27 adjoining towns to total in State, 1896, ...	50
Same in 1897, ...	56½+
Relative per cent. of increase of glanders in Boston and 27 adjoining cities and towns to total in State of 1897 over 1896, .	6½+

During the spring of the present year the Board of Health of the city of Boston secured the passage of the following act: —

[CHAPTER 178, ACTS OF 1897.]

AN ACT RELATIVE TO ANIMALS AFFECTED WITH INFECTIOUS DISEASES.

Be it enacted, etc., as follows:

SECTION 1. Any owner, agent or other person in charge of or called to examine an animal in the city of Boston, affected with either of the diseases known as glanders, farcy or rabies, shall forthwith report to the board of health of said city the name of the owner and place of keeping of such animal.

SECT. 2. Said board, when satisfied upon examination that any animal within said city is affected by either of said diseases, shall cause such animal to be killed or otherwise disposed of.

SECT. 3. Any person violating any provision of this act shall for each offence be punished by a fine of not exceeding one hundred dollars, or by imprisonment in the house of correction not exceeding one year. [*Approved March 19, 1897.*

The Board of Health of the city of Boston employs a competent veterinarian, and has continued the same man in the position for several years, and it is not likely that political changes will interfere with the present incumbent; even if he were removed from his place, in the present state of education and public opinion, it is more than probable that it would be filled by another equally well-educated and qualified veterinarian; therefore, the act as passed cannot be objected to, provided that the cases that occur under his jurisdiction are promptly and fully reported to this Board as soon as the animals are killed.

At the same time, this act established a precedent that might be mischievous and pernicious in the extreme, if it were secured for other cities and towns, where the conditions that exist in Boston do not obtain and are not likely to become the same. It is therefore better that the control of contagious animal diseases be continued in the hands of a central body, having knowledge of the existing conditions of domestic animals in all parts of the State, and in a position to secure and direct co-operation between different localities when necessary.

There has never been any objection on the part of the commission to having glandered horses killed by the local board of health or by the inspector of animals, if the owner was satisfied that the horse was glandered; if he is not satisfied, he should be allowed to resort to the Cattle Commission, as a court of last appeal. In any event, local boards of health should comply strictly with the law requiring all cases to be reported at once and in full to the Board of Cattle Commissioners; and a clause in the law, giving a board of health power to order horses infected with glanders and farcy to be killed, should not exempt it from this obligation.

The Board has been as prompt as possible during the year in dealing with cases of glanders, but in some instances doubtful cases have to be quarantined for some little time before a correct conclusion can be reached. In doubtful cases the most satisfactory method for arriving at a diagnosis has been the test of inoculating guinea-pigs. For a more complete account of this work, the reader is referred to Dr. Frothingham's report. (See page 120.) Mallein has been little used by this Board, and needs further use before it can be decided to just what extent it is valuable.

Rabies.

During 1897, cases of rabies, or suspected cases of rabies, continued to be reported; nineteen of these were dogs. In addition, there was an outbreak in a herd of cattle at South Hadley, in August, resulting in the loss of seven or eight cows, and possibly others in the neighborhood.

Eleven of the rabid dogs were reported during the first

three months of the year; since then, fewer cases have been heard of. It is, therefore, to be hoped that those reported early in the season were among the last of the outbreak mentioned in our annual report of 1897 as beginning in December, 1895; that it has now commenced to rapidly diminish in frequency; and that there will soon be no more occurrences of this malady in Massachusetts for several years, — when, if history repeats itself, as it does, as a rule, there will again be two or three years when this troublesome disorder will reappear.

Late in January, two cases were reported from Waltham, one of which, it was afterward ascertained, had run from Salem and was later found dead in Auburndale. The other dog's origin was unknown; but, as both seemed to have been dangerous, the following letter was sent to the boards of health of the towns through which the Salem dog may have run between that city and Auburndale, where he was found dead: —

COMMONWEALTH OF MASSACHUSETTS.

Board of Cattle Commissioners,
Commonwealth Building, Boston, Feb. 17, 1897.

To the Board of Health.

Gentlemen: — A dog belonging to Mr. E. S. Little of Salem bit Mrs. Little January 26, and then ran away, appearing in Waltham January 27, showing symptoms of rabies and biting several people, and probably dogs also. A few days later his body was found in Auburndale, evidently having died a few days before. Rabbits inoculated from him died of septicæmia, as he was slightly decomposed, but he was undoubtedly rabid. His course was undoubtedly a pretty direct line between Salem and Waltham, and he may have done some damage on his route.

Another dog known to have been rabid, whose origin is unknown, was killed in Waltham about January 20, after having bitten a man.

As there seems to be some danger from rabies as the result of these two cases, we consider it our duty to report the matter to you, in order that you may notify the police of your town to report to you any dogs that may be suspicious, and, if the circumstances seem to warrant it, to order dogs in your town muzzled.

Yours respectfully, Austin Peters,
Chairman.

This letter was sent to Salem, Swampscott, Lynn, Saugus, Malden, Medford, Lexington, Belmont, Watertown, Peabody, Lynnfield, Wakefield, Melrose, Stoneham, Winchester, Arlington, Cambridge, Waltham and Newton.

As a number of cases of rabies were reported to Dr. O'Connell, at Holyoke, late in January and in February, the following letter was sent to the boards of health of Holyoke and adjoining towns: —

COMMONWEALTH OF MASSACHUSETTS.

BOARD OF CATTLE COMMISSIONERS,
COMMONWEALTH BUILDING, BOSTON, Feb. 27, 1897.

Chairman Board of Health.

DEAR SIR: — Dr. Maurice O'Connell of this Board reports an outbreak of rabies among the dogs of Holyoke. We suggest, if the circumstances seem to warrant it, that the boards of health of Holyoke and adjoining towns order dogs to be muzzled, if running at large, or kept under restraint by their owners for ninety days from this date.

The police of these towns should have orders to report dogs acting strangely to the boards of health, such dogs to be secured in a safe place and a notification at once sent to Dr. O'Connell, who will investigate the matter, and, if possible, send the bodies of dogs dying under suspicious circumstances to the laboratory of the Cattle Commission, in order to ascertain definitely whether the dog was rabid, or not.

Yours respectfully, AUSTIN PETERS,
Chairman, for the Board of Cattle Commissioners.

The above letter was sent to Holyoke, West Springfield, Springfield, Chicopee, Westfield, Southampton, Easthampton and South Hadley.

Two cases of canine rabies were reported from Lynn, one in May the other in July. After the one in July, the Lynn board of aldermen, at a meeting July 20, upon the recommendation of the Board of Health and Inspector of Animals, passed an order that all dogs in Lynn should be muzzled until October 1.

On Aug. 25, 1897, Dr. O'Connell received a very urgent call from Mr. Myron Judd, chairman of the local board of health for the town of South Hadley, requesting him to go at once to the farm of Brown & Avery. The farm is located

in that part of the town known as Pearl City, a large portion of which is situated directly at the foot of Mt. Holyoke. In this section of the mountain it is rather woody and quite a place for hunting dogs, as fox hunters go there a great deal. He immediately went there, and found a cow, six years old, a good-looking animal. Her condition was very bad, eyes bulging, muscles twitching, striking the ground with her front feet, moaning and bellowing, frothing at the mouth, arched back, and presenting symptoms of rabies. The animal was immediately ordered quarantined.

On August 28 he was again summoned to the same farm, and found another cow presenting similar symptoms to the first. The first cow seen was found dead at this visit. The skull of No. 1 was opened, the brain removed and sent to Dr. Langdon Frothingham at the Harvard Medical College. Dr. O'Connell, having been appointed by the governor a delegate to the meeting of the United States Veterinary Medical Association, to be held in Nashville, September 7 to 10, left Holyoke on September 3, Friday evening. Before going he placed the matter in the hands of Dr. John Roberts of Northampton, a graduate of McGill University, Montreal, with instructions to keep a close watch of all the animals, and, if any of them showed symptoms of the disease, to immediately quarantine them. Upon Dr. O'Connell's arrival home from Nashville, on the 12th of September, he proceeded at once to the affected farm, and learned that four more head had died, and also that the one that was taken on the 28th was dead. Dr. Roberts reported that five of them died during Dr. O'Connell's absence, all presenting the same symptoms as the first cow.

On September 13 one more was taken sick. This cow died on the 18th, showing precisely the same actions and symptoms as the other six, making in all seven cows which there is good reason to believe had rabies. The man in charge of the farm states that he lost two more cows about two weeks previous to the first visit on August 25. He also says that the two animals acted precisely like the ones that died after the first visit. On September 23, Dr. Frothingham reported that he had made inoculations on rabbits from the brain of the diseased cow sent him, and that the rabbits

came down with the disease, showing unmistakable signs of rabies, therefore confirming the original diagnosis.

On November 23, Dr. O'Connell was called to see another cow on the same farm, showing some of the symptoms that the other cattle had shown before death, but was very much in doubt as to it being identically the same disease. Word was left with the owner, if the cow died, to notify the local inspector at once, and specimens would be taken for a second inoculation. The owner performed his part very faithfully, but the local inspector failed to report the case. About seven days after, Dr. O'Connell learned, through the commissioners of Hampshire County, that the cow had died on November 30; he proceeded at once to the farm of Brown & Avery, exhumed the carcass, and took sections of the spinal cord and shipped them to Dr. Frothingham. These specimens were, however, so decomposed that it was impossible to use them for inoculation purposes.

During the interval of the death of the last cow, September 18 to October 1, there were three or four more cows that died in an adjoining pasture, one belonging to Mr. Cameron and two to Mr. McElwain. Those cases were never reported by the local board of health or by the cattle inspector. All that is known about them is by hearsay; but it is said that their owners are to receive pay from the county commissioners out of the dog fund. The barns where these cattle were kept were ordered to be thoroughly washed with boiling water and bichloride of mercury, one part to five hundred of water. The carcasses of the animals were buried very deep, thereby preventing them from being eaten by dogs.

It is here recommended that all inspectors throughout the State, whenever such cases are reported to them, shall immediately notify the Cattle Commissioners; in fact, they are required to do so by law, as annoying complications are likely to ensue if local authorities are lax in co-operating with the Board of Cattle Commissioners in any cases that may prove to be contagious animal diseases.

In addition to the symptoms described above and the proof afforded by inoculating rabbits from the suspected cow, the cattle also had partly healed scars on the legs, such

as would result from the infliction of dog bites a few weeks previously.

In many instances so-called cases of rabies may be due to some other cause, and it is not unusual to call a dog mad and shoot him if he acts in a peculiar manner, when he may not have rabies. In doubtful cases it is much wiser to secure the dog safely until some one having knowledge of these matters can see him; and, if there is then any uncertainty, rabbits should be inoculated from the fresh medulla and cord, in order to establish a correct diagnosis. This is especially important if the dog has bitten any person or persons; as, if the animal is really rabid, the persons bitten should at once be sent to the Pasteur Institute, in New York, to undergo the protective inoculation for this fatal and terrible malady.

In questionable cases of rabies, reported to the Board of Cattle Commissioners, it has been considered wise to attempt to establish the presence or absence of the disease by having rabbits inoculated; and in a case similar to the outbreak at South Hadley, where the payment for cattle from the dog fund is involved, it becomes a very important matter to determine the exact nature of the trouble.

While it is possible a few of the cases reported to the Board of Cattle Commissioners during the past year were not rabid, yet in many outbreaks it has been proved by inoculation experiments that the diagnosis was correct, in one case that it was incorrect, and two results were neither positive or negative, owing to the decomposed condition of the material.

The following table shows the results of the inoculation proof of absence or presence of rabies: —

Month.	City or Town.	Animal.	Result.
January, .	Boston, . .	Dog,	Positive.
January, .	Boston, . .	Dog,	Positive.
January, .	Boston, . .	Dog,	Positive.
January, .	Waltham, .	Dog,	Positive.
January, .	Waltham, .	Dog,	Negative; dog ran from Salem to Auburndale; sent in by Dr. Peterson, inspector of Waltham; rabbits died of septicæmia.
March, .	Holyoke, .	Dog,	Positive.
August, .	Holyoke, .	Dog,	Negative.
August, .	South Hadley,	Cow,	Positive
November,	Melrose, .	Dog,	Positive.
November,	Sudbury, .	Dog,	Positive.
December,	South Hadley,	Cow,	Negative, because material was not in condition to use; rabbits would have died of septicæmia.

The following table shows the number of cases reported during the year, either rabid, or suspected of being so: —

Month.	City or Town.	Animal.	Number of Cases.
January, ...	Boston, . .	Dog,	3
January, ...	Holyoke, .	Dog,	2
January, ...	Waltham, .	Dog,	2
February, ...	Holyoke, .	Dog,	3
March, ...	Holyoke, .	Dog,	1
May, ...	Lynn, . .	Dog,	1
July, ...	Boston, . .	Dog,	2
July, ...	Lynn, . .	Dog,	1
August, ...	Holyoke, .	Dog,	1
August, ...	South Hadley,	Cow,	2
September, ...	South Hadley,	Cow,	5
November, ...	Sudbury, .	Dog,	1
November, ...	Melrose, .	Dog,	1
November, ...	South Hadley,	Cow,	1
December, ...	Wakefield, .	Dog,	1
Total number of cases reported,	. . . . .	. .	27

Hog Cholera.

Hog cholera seems to be a term indiscriminately applied to any disease swine may be affected with, particularly if several in a piggery are sick at one and the same time.

True "hog cholera" is a specific disease of the pig, having

ulceration of the Peyer's patches of the intestine as a characteristic lesion.

"Swine plague," so called, is a septic pneumonia of the pig, and is sometimes produced by feeding upon decomposed swill. Cases have occurred where "swine plague" has been communicated from swine to horses, sheep, lambs and calves.

Boiling the swill, where city swill is fed, will kill the germs of "hog cholera" and of "swine plague," and after it cools, skimming the grease off the top has also been advised.

Sometimes, after cooking the swill, the pigs will show evidences of "swine plague;" this is probably due to the presence of ptomanes (chemical products of a poisonous character) that have been produced by the growth and development of the septic germs before the swill is cooked.

"Hog cholera" and "swine plague" may both be present in the same pig at the same time, or either may appear in a herd of swine without being associated with the other.

Another disease that has just been brought into notice by the issuing of a recent bulletin upon the subject by the Cornell University Agricultural Experiment Station, written by Dr. Veranus A. Moore, is the poisoning of swine by washing powders and strong alkaline soaps sometimes found in the swill of hotels and public institutions.

The name "hog cholera" is often used indiscriminately by the public in designating these maladies, and a number of cases are reported every year, usually during the winter and spring months.

About the only action necessary seems to be to quarantine the premises while the outbreak lasts, forbidding the sale of swine while any sick ones are left, and advising against the introduction of new ones into the infected herd; separating the sick and well; disinfecting the premises when the outbreak is over; and cooking the swill if it comes from city supplies or public institutions. When the outbreak is over, the quarantine is raised.

Tuberculosis is not at all uncommon among swine; it is usually discovered at the time of slaughter, and is seen chiefly among pigs kept under cow barns where there are tuberculous cows, or, if the cows are diseased, in pens where

the cleanings from the cow stable are thrown, or among pigs fed offal from tuberculous cattle.

For reports upon any lesions sent in for microscopic examinations to Dr. Frothingham, either "hog cholera" or porcine tuberculosis, see Dr. Frothingham's report to the commissioners.

OTHER DISEASES.

In July an outbreak of a disease of an unknown and fatal character was reported from Edgartown. Dr. H. P. Rogers was sent to investigate the matter, July 16; later, he reported that three cows that had recently calved had died, and from what he could ascertain, he thought they had died of parturient apoplexy.

November 20, a ram was quarantined by the inspector at Chilmark, Martha's Vineyard. Dr. H. P. Rogers was sent to investigate this case also, the inspector believing the animal to have "sheep scab." Dr. Rogers reported, December 1, that the ram presented no evidence of "scab."

July 27, Mr. Freeman Hancock of West Tisbury wrote the Board concerning a bowel trouble that attacked members of his family, as the result of using milk from his cows, the first of it being in 1895. Dr. Madison Bunker of Newton was sent to investigate this matter, and made the following report: —

NEWTON, MASS., Aug. 8, 1897.

Dr. AUSTIN PETERS, *Chairman, Cattle Commission.*

DEAR DOCTOR: — In accordance with your instructions, I went to West Tisbury this week and made a visit to the farm of Freeman Hancock.

I found this to be the state of affairs, viz.: at intervals since October, 1895, there has been trouble with milk from three different cows that have been in his pasture; this trouble has been in the spring and in the fall, when the feed has been most succulent and thickest. The milk has been thick when allowed to stand, and the cream would when handled hold together and be ropy like cold molasses, — no smell, no color, no taste.

It has caused diarrhœa in the whole family, with excessive nausea in a ten-months-old child, whose stools were very fluid and very dark green. The child nearly died before the cause was ascertained; as soon as the use of this milk was stopped, recovery came in all the cases. The local physician is said to have found pus in the milk.

A change of cows has been made twice, with cessation of the trouble for some weeks or months, and then a recurrence of the trouble.

The young cow of which Mr. Hancock spoke as having had the trouble lately, has been put in the next pasture, since which time there has been no trouble with her. He has still the old cow in the pasture, but he is raising calves on her, so does not know how her milk now is. I asked him to save some of her milk, try it and report to you. The pasture is a good pasture of the kind, not very rich nor very much run out; has been used for seventy years by this family, and is a part of the location upon which the settlers built when the land was bought from the Indians by William or Thomas Mayhew. There are from seventy to one hundred acres in it. I drove over and around it, but saw no growth or weed which would give me any clue to the trouble, with the possible exception of a strip of land bordering upon a pond, into which the sea breaks, but that is not open, upon which a blue grass grows, and which had been pretty well eaten down, but whether by the cows alone or by the sheep, I could not say.

The water supply is fresh and brackish; there are water holes around the fences, one or two close to this pond, the others one-quarter of a mile away, and then some not so far. Water at barn good and free from taste; drainage away from well. Samples of both cows' milk and of pasture and barn water were taken and sent to Dr. Frothingham; also Mr. Hancock's letter to you, with a request to report to you.

My idea of the trouble is that it is all within the pasture, as when changed from the pasture the milk is all right, also when in the barn. Cows are healthy and bag of old cow OK. Young cow I did not see, as she was some distance away.

I suggested to the owner that he watch his cow as to feeding grounds, and also tramp the pasture to find any weeds. No swamp, no brush in field to cause trouble or for her to browse on.

Yours very truly, MADISON BUNKER.

A few days later Dr. Frothingham reported upon the specimens brought by Dr. Bunker as follows: —

BOSTON, Aug. 13, 1897.

C. C. 77.— Milk and Water from Freeman Hancock, Martha's Vineyard.

From the report received, it seems more than probable that the trouble with Mr. Freeman's cows is referable to some poisonous substance existing in the old pasture. That this substance is of

bacterial origin is not probable, but rather some plant, the poisonous alkaloid of which is excreted in the milk. It would be next to impossible to discover the unknown alkaloid, even if the milk were chemically examined. It also seems unnecessary to undertake a detailed bacteriological examination of either milk or water.

A microscopical examination of the centrifugalized milk from the "old cow" shows a very limited number of pus cells, not enough to warrant a diagnosis of any suppurative process in the udder; less, in fact, than one often finds in the best milk.

FROTHINGHAM.

Mr. Hancock was written to, informing him of Dr. Bunker's and Dr. Frothingham's conclusions; and, as the trouble only appears when the cows are in a certain pasture, he was advised to keep them elsewhere, and use the pasture where the difficulty exists, for sheep.

At the same time, it would be interesting to know definitely what there is in this pasture that causes the milk to be unwholesome for human food, while the general health of the animals appears to be undisturbed.

Respectfully submitted,

AUSTIN PETERS, *Chairman*,
JOHN M. PARKER, *Secretary*,
MAURICE O'CONNELL,
LEANDER F. HERRICK,
CHARLES A. DENNEN,
Board of Cattle Commissioners.

APPENDICES.

Appendix A.

REPORT BY LANGDON FROTHINGHAM, M.D.V.

To the Massachusetts Board of Cattle Commissioners.

Gentlemen: — I herewith submit a report of my work from March 1 to Dec. 11, 1897. It has consisted of the examination of organs or portion of organs received from the inspectors or other agents of this commission. Where it was deemed necessary to establish the exact nature of a pathological change, not sufficiently evident by a macroscopic examination, a microscopic examination was resorted to, or inoculation. The specimens examined will be found classified in an appended table. Besides this, it has been my duty to establish the presence or absence of glanders and rabies in suspected cases by approved methods. Classified tables relating to these diseases are also appended.

Tuberculosis.

The number of tuberculous lesions has not been large, and they were, as a rule, not unusual. One case of marked tuberculosis of the larynx and one of tuberculosis of the trachea are rare, because perhaps, not often sought for. The most interesting specimens were those of miliary tuberculosis of the udder, of which there were three. Such cases are doubly interesting, since it is frequently impossible to differentiate them from other udder lesions before death, and even in some instances upon the autopsy table the existence of tubercles can only be suspected; yet the microscopic examination may show minute tubercles thickly scattered throughout the gland, and it is hardly possible to conceive that in such cases tubercle bacilli do not find their way into the milk.

Actinomycosis.

Actinomycosis of the udder, when the foci are small, may easily be confounded with tuberculosis, and a differential diagnosis is only possible by a microscopic examination. Two such cases have been examined. Actinomycosis of the lungs, when the lesions are small, may easily be mistaken for tuberculosis, if a macroscopic

examination alone is made. One such case is here reported. Only one other instance of this disease was received, and this the usual and easily diagnosticated tumor of the jaw (lump jaw).

Glanders.

The work in this direction has consisted in making a positive or negative diagnosis in suspected cases, according to the method of Strauss (the interabdominal inoculation of male guinea-pigs with suspected discharges). At first the material for inoculation was collected personally, but it was found more expedient for the inspector who visited such cases to obtain the suspected discharge, and bring it, as soon as possible, to the laboratory. It was, therefore, arranged that such inspector should carry with him the following: a test tube properly plugged with absorbent cotton, containing a swab of absorbent cotton wrapped about the end of a stout wire; the whole thoroughly sterilized before being placed in the inspector's hands. As much as possible of the suspicious discharge (nasal or from a farcy-bud) is collected upon this swab, at once returned to the test tube and brought to the laboratory. Here sterilized water is added, the cotton swab freed from the wire and left in the water. This is then violently shaken, until all large particles of the discharge are dissolved, the cotton squeezed as dry as possible with sterile forceps, and the solution thus obtained used for inoculation, two guinea-pigs being invariably employed. Unfortunately, the guinea-pig is not as susceptible an animal as one could desire for such work, but is the only accessible one, and if virulent glanders bacilli are present in sufficient number, the typical lesions of the testicle appear in from two to five days after inoculation. In only one instance of a positive inoculation were these lesions absent, and in this case cultures of the glanders bacillus were obtained from the spleen sixteen days after inoculation, when the animal was killed. A second guinea-pig, however, inoculated at the same time, showed the testicle lesions on the second day.

A glance at the annexed table may intimate a preponderance of negative results; but it must be remembered that these inoculations were undertaken for the purpose of diagnosis, and that these horses were only doubtful cases of glanders. The more suspicious negative cases were tested twice, to be doubly sure of the absence of glanders bacilli. One horse that gave a negative test was subsequently killed, and glanders nodules found in the lungs at autopsy; no lesions were found upon its nasal septum, however, and only a clear, watery discharge from the nose had been

obtained for inoculation. Several other negative tests were also made, where the discharge used was unsatisfactory. It is interesting to note that in all the positive inoculations the discharge was obtained from the left nostril, while in the negative inoculations the discharge was, in the majority of cases, from the right, or, as above stated, unsatisfactory. In only one positive case was a second inoculation necessary, and here because the pigs died about thirty-six hours after inoculation, of peritonitis, due to other organisms than the glanders bacillus present in the discharge.

A most interesting positive inoculation was from a man in Lynn. There was a clear history of his having a wound upon the hand, and of his constant attendance upon horses suspected of having glanders. When seen, the lesions of glanders upon the hand had healed to such an extent that it was impossible to obtain material for inoculation. At that time he had had these lesions and enlarged axillary glands for about three months. From a sluggish lesion upon the instep, however, a serous discharge was obtained, which, when inoculated into guinea-pigs, gave rapid and positive results.

Rabies.

But few cases of this disease have been investigated. They are classified in a special table. The most interesting was that of a cow, this animal being supposed to have been bitten by a dog some time before she showed symptoms of disease; and rabbits, inoculated according to the method of Pasteur, gave positive results. This cow was one where several others died in a herd at South Hadley, showing similar symptoms, and having scars of dog-bites on their legs.

Tables.

[It is assumed that, where an organ was tuberculous, the lymphatic glands of that organ were also tuberculous. Hence in the following table only such glands are mentioned as were sent unaccompanied by other organs.]

Specimens Examined.

Cattle: —	
Aberrant supra-renal tissue in the kidney,	1
Abscess of liver,	9
Abscess of udder,	2
Adenoma of pancreas,	1
Actinomycosis of lung,	1
Actinomycosis of udder,	2
Actinomycosis of superior maxillary bone,	1
Angioma of liver,	1

Atalectasis,	1	
Atalectasis and bronchitis,	2	
Bronchitis (chronic),	2	
Cancer of omentum,	1	
Cysts of udder,	2	
Cysts of kidney,	1	
Dermoid cyst,	1	
Fat foci in liver,	1	
Fat foci in muscle,	1	
Foreign body in heart,	1	
Œsophagostoma,	2	
Nephritis (chronic),	1	
Mastitis,	3	
Multiple necrosis of liver,	1	
Pleuritis,	1	
Pneumonia,	12	
Tuberculosis of lungs,	8	
Tuberculosis of lungs and pleura,	4	
Tuberculosis of liver (peritoneal surface only),	2	
Tuberculosis of larynx,	1	
Tuberculosis of lymphatic glands (only glands sent),	5	
Tuberculosis of omentum,	1	
Tuberculosis of trachea,	1	
Tuberculosis of udder,	4	
Texas fever,	5	
	—	82
Swine: —		
Bronchitis and atalectasis,	1	
Hepatitis (chronic interstitial),	1	
Hog cholera,	2	
Hydronephrosis,	1	
Pericarditis (chronic),	1	
Pleuritis (chronic),	1	
Pneumonia and pleuritis,	1	
Pneumonia,	2	
Tuberculosis of lungs,	5	
Tuberculosis of liver,	3	
	—	18
Horses: —		
Fibro-cysto-adenoma of intestine,	1	
Glanders of lymphatic glands,	2	
Glanders of lung,	2	
Glanders of nasal septum,	2	
	—	7
Normal organs examined,	24	
Doubtful diagnosis,	3	
Decomposed,	3	
	—	30
Total of specimens examined,		137

Inoculations for Diagnosis of Glanders.

	Negative.	Positive.	
Inoculation of nasal discharge from suspected horses,	12	5	
Inoculation of discharge from supposed farcy-bud, .	3	3	
Inoculation of discharge from lesion on instep of man,	–	1	
	15	9	
			24

Rabies, 1897.

ANIMAL.	Town.	Rabbits Inoculated.	Appearance of First Symptoms.	Days Elapsed.
Newfoundland dog, .	Holyoke,	March 24,	April 6,	13
Pug dog, . . .	Lynn, .	June 4,	June 16,	12
Cow, ...	Holyoke,	August 31,	September 21,	21
French poodle, . .	Melrose,	November 13,	November 29,	16

Number of negative inoculations, ... 2
Still under observation, ... 3

Disposition of Tuberculous Animals and the Restriction of Tuberculosis in Cattle.

Your honorable Board has requested me to express an opinion as to the existing laws regarding the disposition of tuberculous animals and methods of restriction of tuberculosis in cattle.

Disposition of Tuberculous Animals.

According to the letter of the present law, if a single tubercle, not even the size of a pin's head, is discovered in the body of an animal, such animal cannot be used for food, but is consigned to the rendering tank; moreover, the State must pay the owner of such animal its full value. Such a law, it seems to me, sanctions wanton waste of excellent food, and is far removed from the ground principles of economic science. The laws of the most advanced European States have been the outcome of careful observation, practical experience and scientific study. For the most part, they are essentially the same as the United States law covering this subject, and for the State of Massachusetts I advocate a law more in harmony with these than the present one is.

The Restriction of Tuberculosis in Cattle.

Though feeling strongly that our existing laws relating to this much-debated subject are inadequate, I am, without much more careful thought and study, unwilling to suggest others.

The thorough science of the Germans is universally respected; their laws covering every grade of meat inspection are admirable, and the result of the best thought and scientific study of men well able, therefore, to dictate; yet at present there are no laws in Germany especially relating to the subject in hand. The nation is not idle, however, and is carefully watching and investigating the experiments in progress in other countries, and, as an eminent scientist of our own land has perhaps well said, when they do adopt measures for the restriction of tuberculosis in cattle they will probably be wisely economic, more efficacious and in every way better than have as yet been attempted. I, therefore, advocate wise delay and a careful study of the shortly forthcoming recommendation to the German government now being prepared by one who has recently returned from Denmark, where he was sent to make an exhaustive study of Bang's work, methods and results. In these recommendations we may find many valuable suggestions applicable to our country with but slight alteration. At least, they may offer us new and better lines upon which to proceed. Nothing is to be gained by extreme haste. Tuberculosis has been of very gradual growth in our cattle, and it is possible that its decrease and final control must be also a gradual process. The peculiar nature of the disease seems to indicate this; it is not an acute infectious disease, and, therefore, should not be treated as such.

Before proceeding too hastily, would it not be judicious to inquire thoughtfully into the cause of the present crusade against tuberculous cattle? I therefore suggest the following for careful consideration: —

Why the slaughter of so many tuberculous cattle and the waste of so much good food? If the answer to this question is that it is to protect human beings against tuberculosis, we must then consider the following questions: Are tuberculous cattle and their products a cause of tuberculosis in man? If so, to what extent? Are there not other causes far more dangerous, and hence much more important to control?

In partial answer to the above queries, it may be said that, although many cases of tuberculosis in human beings are thought to be directly traceable to cattle, not one, in the vast literature upon the subject of tuberculosis, has been authentically established, so that this question is still an open one. On the contrary, it is universally acknowledged that tuberculous people, especially through their sputum, are an immense source of infection to other people and to themselves. That tuberculosis in man may, in some instances, be referable to tuberculous cattle, I firmly believe; but

this source of danger is greatly minimized, when we consider other possibilities of infection.

Careful and regular inspection of dairy herds by competent veterinarians is, in my opinion, a duty that the State should not ignore; but that the inspectors should limit themselves to the detection of tuberculosis only, I believe to be unwise. Various inflammatory and septic conditions of the udder, for instance, are acknowledged causes of bad, unwholesome milk; it is, therefore, evident that milk from such udders should never be used. Pure milk, however, is dependent upon the general health of the animals supplying it, and this, in turn, is dependent upon good hygienic surroundings. Bad hygienic conditions, again, are conducive to the spread of tuberculosis; hence, broad work in this direction would materially assist in reducing the amount of tuberculosis in cattle. Therefore, until manifestly sound laws for the direct suppression of tuberculosis in cattle are forthcoming, there is a wide field for energetic labor which indirectly will gradually be attaining a similar end.

Respectfully submitted,

LANGDON FROTHINGHAM.

APPENDIX B.

PRELIMINARY REPORT UPON A COMPARATIVE STUDY OF TUBERCLE BACILLI FROM MAN (SPUTUM) AND FROM CATTLE.

BY THEOBALD SMITH, M.D.

For a number of years past the writer has been impressed with certain differences in the lesions produced in the guinea-pig by the tubercular products of cattle, on the one hand, and by sputum from human beings containing many tubercle bacilli, on the other. These differences are not great, nor are they easily described; but they were of sufficient moment to induce the writer to attempt some experiments, to find out to what extent they depended on differences in the bacilli of human and of bovine tuberculosis, and whether such differences were of sufficient intensity to be brought out by the bacteriological and pathological methods in use.

A beginning was made in 1895 with a fresh culture of bovine tubercle bacilli and a fresh culture of bacilli from an animal (*Nasua narica*) which had lived with a tuberculous master. It was assumed then, and all evidence is in favor of the assumption, that this animal had been infected from its master, and that the tubercle bacilli obtained from it could be classed as human. The careful study of other sputum bacilli subsequently also supports this assumption. The experiments made with these cultures have been fully reported elsewhere,* but I shall include them in the summary of the work done more recently, as the methods pursued are the same, and the results therefore comparable. No opportunity was given to continue this work until this year (1897), when the Board of Cattle Commissioners offered to furnish me cattle and to provide the food for their maintenance during the period of the experiments. At the same time, the State Board of Health, fully cognizant of the important bearing of this work

* Transactions Association American Physicians for 1896, pp. 75-93; twelfth and thirteenth annual reports of the Bureau of Animal Industry, United States Department of Agriculture, p. 149.

upon the public health, authorized me to use its laboratory facilities, without which aid a further pursuit of the subject would have been impossible. Some of the work was also done in the newly established laboratory of comparative pathology of the Harvard Medical School.

A full report of this work, including a description of the method employed for cultivating the bacilli of tuberculosis, the preliminary experiments upon small animals (rabbits and guinea-pigs) and the microscopic study of the diseased tissues of the animals experimented upon, will be given at another time. In this report I shall restrict myself to that portion of the work having reference to the immediate relationship and differences between human (sputum) and bovine tubercle bacilli, as determined by experiments upon cattle.

Inasmuch as up to the time of the first experiment nothing was known of the effects of bovine tubercle bacilli inoculated into cattle, and very little, if anything, of the effects of tubercle bacilli from man inoculated into the same species, the methods of dealing with this subject had to be, as it were, developed during the course of the work. One thing, however, was deemed essential. The tests to be made with human and with bovine bacilli upon cattle must be conducted under as uniform conditions as were possible, under the circumstances. Only by showing differences in the action of tubercle bacilli from these two sources under the same conditions can we prove any actually existing differences in the bacilli themselves. Absolute uniformity was unattainable, but I think the records will show with few exceptions a uniformity in all important details.

In all cases the various cultures of tubercle bacilli were isolated by me. Cultures of unknown age and source, borrowed from others, were not employed. Products of the disease, tuberculous tissue from cattle, in one case from swine, and sputum from human subjects were inoculated into guinea-pigs, and from them, after three to six weeks, cultures on dog's serum were obtained. These were tested subsequently upon rabbits and guinea-pigs, and lastly on cattle.

The mode of testing the cultures upon cattle deserves a brief description. In all cases the growth on blood serum was stirred up in sterile bouillon until a clouded suspension was obtained, which corresponded in depth to a bouillon culture of typhoid or hog-cholera bacilli about twenty-four to thirty-six hours old. This was injected with a hypodermic syringe into the thoracic cavity through the right chest wall, the intent being to deposit at least a portion of the suspension in the lung tissue. This method

of introducing the bacilli was chosen because it was likely to furnish the most uniform conditions, and also because tuberculosis of the organs of the chest is the most frequent form of disease among cattle.

Experiment I. — This, as stated above, was made in 1895, with two cultures, one from an old bull, with advanced generalized disease, involving also some of the bones, the other from a tuberculous animal probably infected from its tuberculous master.

Two heifers were inoculated with these cultures, as described above. The one receiving the bovine culture died in thirty-five days, with miliary tuberculosis of the lungs and general tuberculosis disseminated throughout the body. The one receiving the presumably human culture showed no signs of disease, and when killed fifty-four days after inoculation, not even a local lesion could be traced.

Experiment II. — This experiment was carried out two years later, in 1897, and included four head of cattle. The tubercle bacilli were obtained from the following sources: —

Sputum culture II., from a rapid case of phthisis in New Bedford, Mass.

Sputum culture III., from a subsequently fatal case of phthisis in Norwood, Mass.

Bovine culture II., from an old cow slaughtered in Lawrence, Mass., in which there was slight disease of the lungs and mediastinal glands (specimens brought me by Dr. Alexander Burr).

Swine culture I., from swine living under a cow barn in Massachusetts (specimens obtained by Dr. Austin Peters). This culture in every way appeared identical with the bovine cultures, and this, together with the fact that the swine were exposed to infection from cattle, led me to assume that this was a bovine culture in origin.

On May 1, 1897, these four cultures were injected into four head of cattle. The total age of the cultures, or, in other words, the total period of time during which they had been growing on dog's serum, was as follows: —

Sputum culture II., five months, nine days old, eighth transfer.

Sputum culture III., two months, fifteen days old, fourth transfer.

Bovine culture II., five months, two days old, fifth transfer.

Swine culture I, eleven months, twenty-three days old, sixteenth transfer.

Assuming that tubercle bacilli become slowly weakened in virulence by artificial cultivation, we should endeavor to use cultures as fresh and of as nearly the same age as possible. This

theoretical demand cannot be successfully met, because of the many difficulties surrounding such work. Of the four cultures used, sputum II. and bovine II. are of nearly the same age, while sputum III. is but half as old as they, and swine I. more than twice as old. In making the injection, the space between the sixth and the seventh rib was chosen. The needle was inserted about three inches above the level of the elbow (olecranon process). It was found subsequently at the autopsy that the point chosen was too low, and that in all of the animals the needle, leaving the lungs intact, pierced the diaphragm. Some of the bacilli were thus discharged into the abdominal cavity.

Bearing this unforeseen accident in mind, we may now go to a description of the further history of the inoculated cattle. They were all housed in a spacious, well-ventilated barn, in large, commodious horse stalls. A piece of ground adjoining the barn was enclosed, and in this the animals spent six to seven hours a day for about four weeks. Thereafter the animals were separated into two lots, one lot being out several hours in the morning, the other several hours in the afternoon. The two which received the bovine and the swine culture were allowed to run together, similarly the two which received the sputum cultures. It might be claimed that there was in this arrangement a possible danger of transmitting the bacilli from one animal to another, and of infecting the ground. There was no evidence of this at the post-mortem examination; and the arrangement was considered safe at the start, because it takes some time for the tuberculous tissue to become disintegrated. Only when this has set in can we consider the passage of bacilli from one animal to another possible. It was, however, deemed prudent not to keep the animals longer than two months, on account of the imperfect isolation.

In apportioning the cultures to the animals, the sputum cultures were injected into the youngest animals, in order that these cultures might have any advantage likely to accrue from differences in age. Two yearlings (without any permanent incisor teeth) received the two sputum cultures, the bovine culture was injected into a heifer about two and one-half years old, the swine culture into a heifer about two years old.

They were killed and examined at the Brighton abattoirs, with the co-operation of the Board, just two months after the day of the injection. Before inoculation these animals had been tested with tuberculin by the Board, and found free from tuberculosis. Still, since this agent occasionally allows an animal to escape which contains foci of the disease, attention was directed to this point at the autopsies. No lesion, however, was found, which

from its situation and appearance could be referred to any former spontaneous infection.

Let us examine first the effect of sputum culture II. and bovine culture II. which were of nearly the same age when injected.

The weight of the yearling (2616) receiving the sputum culture had risen in the two months from 520 to 580 pounds, that of the heifer (2635) from 650 to 710 pounds. There was no continuous fever recognized in either animal, though the temperature was taken twice a day, morning and afternoon. The fluctuations noticed were evidently due to the effect of the sun while the animals were in the enclosure.

The lesions in the yearling (2616) were very slight. At the seat of inoculation, between the sixth and seventh ribs, a mass of tubercles attached to pleura about one by one-half inch dimension, the tubercles composing it partly cheesy, partly firm. Near cephalic border of ventral lobe of right lung, a sub-pleural nodule, not yet necrotic, about one-eighth inch in diameter. On abdominal aspect of diaphragm, right side, about twenty-four isolated tubercles, each one-twelfth to one-eighth inch in diameter, uniformly yellowish in color. A few similar tubercles on the omentum. Slight adhesion of omentum. When adhesion removed, about six or seven nodules found on cæcum, one-twelfth inch in diameter. Evidently the injection needle had passed through diaphragm into abdomen, deposited some fluid there and some in thorax when partly withdrawn.

The lesions in the heifer which had received the bovine culture were quite extensive, and were diffused through thorax and abdomen, owing to the penetration of the diaphragm by the needle of the injection syringe: —

Thorax: The right pleural cavity shows an abundant eruption of tubercles along the lateral margin of the ribs. Some of the masses formed are characteristically flattish, grape-like, and in bulk quite large. One mass measured eight by three by one inch. Others of similar dimensions were present. On the lateral margin of the right lung a series of loosely attached flattish neoplasms, up to two inches in diameter, besides hyperæmic fringes of loose connective tissue. On the convex surface of this lung only a few tubercles. Large patches of tubercles on pericardium and diaphragm.

In the muscular portion of diaphragm, right side, a mass of tuberculous tissue (probably place where needle penetrated), one and one-half by one and one-half by one-half inch in dimension. The most caudal of the series of dorsal mediastinal glands about twice normal size, on account of the presence of many small foci, showing in some cases an opaque, yellowish centre.

Abdomen: The omentum densely studded with agglomerations of tubercles, covering the greater part of its surface. These masses vary

up to one-half inch in thickness. Similar patches on abdominal aspect of diaphragm and on spleen. Fewer patches on gall bladder and on the liver. In one of the portal glands a one-quarter inch focus, pale, grayish, permeated with small, calcareous spicules.

We have in these cases a wide divergence in the result of the inoculation. The human bacillus produced a slight eruption of small, tubercle-like bodies, which did not even present microscopically the characters of true tubercles; while the bovine bacillus produced an exquisite case of pearly disease both in thorax and abdomen, with the formation of large, grape-like masses in the chest. These, under the microscope, presented all the characters of genuine tubercles, and contained tubercle bacilli.

The youngest sputum culture (No. III.) was injected into a yearling weighing 410 pounds. At the end of two months the weight had risen to 480 pounds. The lesions found are slight: —

On the abdominal aspect of diaphragm, right side, a patch of isolated tubercles about two inches in diameter, the tubercles themselves about one-sixth inch diameter, and about one-half inch apart. They are grayish, opaque. At place of inoculation, on serous aspect of ribs a flattish neoplasm, one inch in diameter and about one-eighth inch thick. Other lesions not detected.

In this case also the needle evidently entered abdomen through diaphragm. The notes show very little disturbance as the result of the inoculation.

The swine culture was injected into a somewhat older animal, weighing 620 pounds. After two months the weight was 660 pounds. The autopsy showed the following condition: —

At place of inoculation (right chest wall) a subcutaneous tumor about two inches in diameter, made up of a very dense connective tissue sac one-quarter inch thick, and which encloses a pale, yellowish semifluid mass. . . . There are besides this focus in the same situation three smaller nodules, from one-half to three-fourths inch in diameter, the largest with caseous centre. On the pleural aspect a similar one-half inch centrally softened focus.

In nearly the centre of the right half of diaphragm and projecting into abdomen for one-half inch is a tumor representing a portion of a larger focus in the muscular portion of the diaphragm about one inch in diameter. This focus is likewise caseous diffluent centrally. On all the ribs of right pleural cavity are eruptions of small tubercles, reaching in some instances a diameter of one-eighth inch. Besides the palpable tubercles there is along one border of each rib a line of vascular fringes of connective tissue. In many of these fringes tubercles not noticed, although the fringes themselves are evidently a result of the injection.

Along the lateral border of the right lung similar vascular fringes of tissue containing tubercles. These fringes extend dorsad for about two inches on ventral and cephalic lobes.

Diffuse eruption of minute tubercles on pleural aspect of diaphragm, right half

Large caudal mediastinal gland contains large numbers of tubercles, varying in size from mere points to those one-eighth inch in diameter, and showing beginning necrosis. Left bronchial gland several times normal size. Ventral mediastinal gland several times normal size, and containing several large centrally caseous foci. One mesenteric gland contains several small necrotic tubercles.

In this case many of the bacilli had been deposited in the fleshy portion of the diaphragm and some under the skin, and they were thus prevented from exerting their greatest power; nevertheless, the lesions are quite severe. It is not improbable that this culture would have been much more destructive had it been used six or seven months earlier.

Experiment III. — This comprised six head of cattle. The details of the experiment do not differ from those of experiment II. The animals had been tested with tuberculin under the direction of the Board.

The cultures of tubercle bacilli used in these tests were from cases of human and bovine disease, and comparatively fresh: —

Sputum culture IV., six months, ten days old, from a case of phthisis in Melrose, Mass. Patient was subsequently reported recovered.

Sputum culture V., one month, nineteen days old, from a case of phthisis of about two years' standing (New Hampshire).

Sputum culture VI., one month, twelve days old, from a case of phthisis in Winthrop, Mass.

Bovine culture III., four months, seven days old, from a cow with advanced lesions of lungs and liver (probably from Carlisle, Mass.).

Bovine culture IV., four months, three days old, from a cow with slight disease of mediastinal glands.

Bovine culture V., four months, three days old, from a cow with moderate disease of the lungs and portal gland.

This set of cultures is thus younger than the preceding set, with odds in favor of two of the sputum cultures. The bovine cultures were of nearly the same age.

The animals at my disposal were, unfortunately, not of the same age, and in assigning the cultures the advantage was given to the human cultures: —

Sputum IV., yearling, 525 pounds, no permanent incisor teeth.

Bovine III., yearling bull, 645 pounds, no permanent incisor teeth.

Sputum V., cow, 675 pounds, about four years old.

Bovine IV., cow, 850 pounds, about twelve years old.
Sputum VI., cow, 865 pounds, about three and one-half years old.
Bovine V., cow, 875 pounds, about six years old.

The injection of the cultures was carried out as in experiment II., excepting that the point of insertion of the needle was chosen higher up, about eleven inches above the elbow of the animal when in the standing position. The length of the needles used was about two inches.

The care of the animals was the same as that bestowed on the preceding lot, excepting that the bovine and the sputum animals were kept separate in the out-door enclosure from the start, the one lot being out in the morning, the other in the afternoon. They were kept two months, with the exception of the young bull (bovine culture III.), which died seventeen days after the inoculation. The four cows of this lot gave at the start altogether about eight quarts of milk. The amount slowly diminished, until in the sixth week a very little, amounting perhaps to one quart in two days, was removed. The milking was continued chiefly to prevent any udder troubles during the experiment, and to maintain normal conditions. The temperature was taken but once a day, at noon.

In comparing the temperature records of these six animals, it was noticed that the three animals which received the bovine cultures had a high temperature immediately after the inoculation, which lasted until the death of the bull and about three weeks for the remaining two animals. At the same time, no such elevation of temperature was recorded for the animals receiving the three sputum cultures. There was but one well-defined rise of temperature in case of the yearling, from the thirteenth to the sixteenth day after inoculation. The other irregularities are probably due to the fact that the temperature was usually taken after these animals had been in the enclosure in the sunshine for several hours. Those with the high temperature were kept much of the time in the cool barn in the morning, which probably depressed the fever curve somewhat. These temperature records are given at the end of this article. After the period of fever no other elevations were noted up to the close of the experiment.

The young bull, inoculated with bovine culture III., showed, besides the prompt onset of a high temperature, general and local disturbances about a week after the inoculation. The breathing became rapid, the appetite had partly gone. Emaciation and weakness supervened. He was unable to get up September 11, and died the following night.

The autopsy revealed a severe miliary tuberculosis of both lungs, with marked congestion and œdema of the organ. Normal collapse no longer possible. The associated lymph glands were much enlarged and infiltrated with minute tubercles. Patches of minute tubercles were found on the pleural covering of ribs and on the omentum. In the liver many minute tubercles were found in sections. In these, as well as in the tubercles of the lungs and mediastinal glands, tubercle bacilli were very abundant. The other organs have not yet been examined microscopically.

On October 27, the remaining five animals were killed at the Brighton abattoirs, with the co-operation and assistance of the Board.

The three sputum animals had all gained in weight: —

Yearling (sputum IV.), from 525 to 610 pounds.
Cow (sputum V.), from 675 to 750 pounds.
Cow (sputum VI.), from 865 to 960 pounds.

No. 79 (sputum culture IV.).—Yearling. One permanent incisor on the right has appeared since date of inoculation. In utero a fœtus about three months old. At point of inoculation in the subcutaneous tissue a small nodule about one-quarter inch diameter, with contents soft, cheesy. Attached to this is another smaller nodule, about one-eighth inch diameter.

On the right side of chest wall, pleural aspect, there are attached along the six caudal ribs, soft, dark-red, pendulous masses of newly formed connective, highly vascular tissue. At point of inoculation, between seventh and eighth ribs, a flattish pedicled mass of tissue of brownish-red color. On the tenth rib another mass, about three-eighths inch diameter. The left side of thorax is normal.

Right lung: On the small (cephalic and ventral) lobes newly formed, delicate fringes of hyperæmic connective tissue, which appears along the free lateral margin as a delicate band about one-half inch broad, as well as on a portion of the surface of the lung, occupying exclusively the lines representing the boundaries of the lobules.

In the large caudal lobe, which is similarly beset with the vascular fringes, a tumor, representing the place where needle penetrated lung tissue, projecting slightly above the convex surface, is found two inches from the caudal tip. This tumor, about three-quarters inch in diameter, contained a completely disintegrated mass and about a dozen foci, one-sixteenth to one-eighth inch in diameter, with yellow softened centre. On the margin of this same lobe, in addition to the vascular fringes are four firm masses of grayish tissue, smooth, flattish, attached by pedicles to margin of the lobe Their largest diameter is from one-quarter to one-half inch.

On large (caudal) lobe ot eft lung there is only a very little development of vascular fringes. Imbedded in the same lobe near lateral margin is a uniformly grayish, slightly translucent mass, sharply defined from the enveloping normal lung tissue.

Attached to the cephalic lobe of the left lung by a pedicle is a small, flattish, smooth mass of new tissue.

The pleural aspect of diaphragm and portions of the pericardium are covered with areas of the highly vascular, neoplastic tissue. In some, small nodules can be felt at the free extremity of this tissue.

On the right ventricular surface of the heart four flattish pedicled masses, about as large as split peas, are attached.

The various lymph gland systems, ventral and dorsal mediastinal and bronchial glands, do not show the presence of tubercles or any augmentation of size.

No. 39 (sputum culture V.). — Cow about four years old. In utero a fœtus three to four months old.

Development of vascular fringes along one border of ribs of the right side of thorax, as in preceding case, but amount slight, compared with that case. In the intercostal muscles at the point of inoculation a mass of perhaps a dozen small, grayish tubercles.

Right lung: In the large caudal lobe, in the same situation as preceding case, a projecting tumor about one inch in diameter. When incised it is found composed of two one-half inch foci of disintegrated cheesy-viscid matter, enclosed in thin, smooth capsules. No surrounding infiltration.

Along the margin and on the caudal surface of this lobe slight development of pendulous vascular tissue and a sessile tubercle about three-sixteenths inch diameter. On the left caudal lobe only very slight production of vascular tissue.

On the surface of one of the middle dorsal mediastinal glands an aggregation of minute tubercles one-half inch in diameter. Imbedded in the cortex of the same gland two minute tubercles.

No. 76 (sputum culture VI.). — In utero a fœtus about four months old.

Within the thorax, on the right side, between the seventh and eighth ribs, is a small, pedicled, blackish (hemorrhagic) mass of firm tissue about as large as a pumpkin seed, another on the tenth rib. On most of the ribs behind the seventh are gelatinous-looking pendulous vascular fringes of neoplastic tissue. On the pleural surface of the diaphragm a similar development of vascular tissue and several firm pedicled masses like those on ribs.

Of the right lung the cephalic lobe shows very slight formation of marginal fringes. In the ventral lobe, whose tip is adherent to the pericardial fat, a uniformly grayish, sharply defined focus, one-quarter inch in diameter.

In the same situation as in the preceding cases the caudal lobe shows a slightly projecting tumor, about one and three-quarters inches in diameter externally. When incised it is found to consist of a smooth-walled sac, one and one quarter inches diameter, containing a yellowish curdy mass, together with a little turbid fluid. No surrounding infiltration. On the convex surface of this lobe there is a slight growth of vascular tissue. Near the caudal tip a flattish mass, partly yellowish, partly blackish, attached by loose tissue to the margin of the lobe.

In the abdomen, a flattish, sessile mass of pinkish gray tissue, about three-quarters of an inch in its longest diameter, attached to omentum *

Of the three animals receiving bovine tubercle cultures, the fate of one (young bull No. 71) has already been given. The two other cases remained stationary in weight: —

No. 88, original weight, 850 pounds; weight at end of experiment, 850 pounds.

No. 63, original weight, 875 pounds; weight at end of experiment, 970 pounds.

The autopsy notes are in brief as follows: —

No. 63 (bovine culture V.). — White cow, spotted with red. Horns sawed off. Probably six years old. Fœtus in utero, about two months old.

Thorax: Right lung adherent to chest wall in several places. At point of inoculation, between seventh and eighth ribs, an excrescence, about three-quarters inch in diameter, of dense, pearly-looking connective tissue, enclosing a disintregated mass. Numerous masses and aggregations of small tubercles on all ribs; these in some cases several inches in length The left side of thoracic wall, below the level of the point of inoculation on the opposite side, is covered with a uniform, pinkish-gray deposit of very minute tubercles. Eruptions of tubercles on pleural surface diaphragm and on pleural covering of dorsal mediastinal space.

On caudal lobe of right lung a considerable number of tubercular masses, flattish, sessile, from one-eighth to three-quarters inch in diameter. Between the cephalo-lateral border of this lobe and the pericardium is a mass of newly-formed tissue, dense, in which are imbedded many minute yellow tubercles and masses of pericardial fat. The whole is about as large as a fist. It binds the lung tissue, pericardium and diaphragm together.

Many tubercles on the caudal surface of this same lobe.

There is no distinct focus in this lobe, as a result of the injection, and it is probable that much of the fluid was deposited in the pleural cavity. But palpation reveals throughout both lungs small shot-like bodies, in close proximity. On section numerous yellow tubercles from one-thirty-second to one-sixteenth inch in diameter are found imbedded in the lung tissue of all lobes.

The dorsal mediastinal lymph glands are all several times normal dimensions. They contain many coalescing yellow tubercles. The ventral (anterior) mediastinal glands are similarly enlarged, and the cut surface shows a uniformly cheesy parenchyma.

Minute grayish points under the capsule of the liver.

* The character of these peculiar formations will be described in a subsequent report.

In the spleen, all malpighian bodies converted into tubercles with yellow, opaque centre. In left kidney several minute grayish tubercles.

No. 88 (bovine culture IV.). — Red and white cow. Teeth very much worn; probably twelve years old; dehorned. Not pregnant

Thorax: No deposit at point of inoculation. The eruptions of tubercles on the costal pleura of the right and the left side are in character very much like those of the preceding case (No. 63), but less extensive.

Right lung: Lobes adherent to pericardium. Adhesions readily severed. On convex surface of the caudal lobe of this side a considerable number of flattish sessile tubercles, from one-sixteenth to one-half inch broad. The caudal aspect of this lobe is similarly beset with them, but in less abundance. Along the margin of this lobe are loosely attached small elongated masses of tubercles.

At the same situation in this lobe as in the sputum cases there is a fluctuating tumor, about two inches in diameter, slightly projecting. It consists of a capsule with nearly smooth walls, enclosing a soft caseous mass. It is surrounded by a zone of small necrotic tubercles, and with lobules containing numerous minute grayish foci.

On the cephalic lobe of the right lung a considerable number of grayish tubercles. Throughout all lobes are many tubercles in the lung tissue, some very minute, others larger and opaque, yellowish in color.

The pleura in the dorsal mediastinal space is beset with a large number of small tubercles, similarly the pericardium. The right half of the diaphragm is beset with flattened aggregations of tubercles. Between the ventral lobe of the right lung and the pericardium, and fastening them together, is a mass of newly formed connective tissue and fat, enclosing numerous softened foci.

The large dorsal mediastinal lymph gland is enlarged, and contains a large number of yellow tubercles. The central portion of the gland is uniformly caseous. In the left bronchial gland, a small number of tubercles; in the ventral mediastinal glands, a considerable number.

Organs of the abdomen appear free from visible tuberculous changes.

A summary of the outcome of this last experiment may now be made.

The points of difference between the inoculation disease produced by bovine and by human (sputum) bacilli are several: —

1. The bovine cases either remained stationary in weight or lost slightly, while the sputum cases gained seventy-five to eighty-five pounds. Still, the age of one of the bovine cases may be partly responsible for stationary weight.

2. There was marked fever in the bovine cases for three weeks after the inoculation, practically none in the sputum cases.

3. There were well-marked differences in the lesions produced. In the sputum cases the lesions are practically the same, and consisted in: —

(*a*) A tumor in the right caudal lobe of the lungs, about one inch in diameter, projecting somewhat above the surface of the lung. This

represents the place where the needle penetrated into the lung tissue and deposited the tubercle bacilli. In each case the contents of this tumor were softened and converted into a curdy mass, enclosed in a thin-walled capsule, smooth internally. The disease was not spreading from this point, nor were tubercles visible in the lymph glands of the lungs and thorax, excepting in one gland of No. 39.

(*b*) The free margin of the right lung, the pleural covering in part and the pleural covering of the ribs on the right side were beset with a new formation of loose vascular fringes or shreds, in which in only one case some minute nodules could be felt, also some flattish pedicled masses, not resembling tubercles.

Among the bovine cases we have the following characteristic points to note: —

(*a*) Disseminated tuberculosis of the lungs, severest and fatal in No. 71, the youngest, least pronounced in the oldest, No. 88. Associated with this, a local disintegrated focus in the lungs of No. 88.

(*b*) Tubercular deposits on lungs, pericardium and diaphragm, and the ribs, resembling closely the product of the natural disease in cattle. The few pedicled masses attached to the pleura in the sputum cases bore no direct resemblance to tuberculous outgrowths, although they are undoubtedly the result of the inoculation.

(*c*) Extensive tuberculosis of all or nearly all the lymph glands of the thorax, including both mediastinal chains.

(*d*) Tuberculosis of other organs, spleen, liver, kidney, in two out of three cases.

A summary of the three separate experiments, in which 12 animals were used, shows that: —

6 animals were inoculated with human bacilli.
5 animals were inoculated with bovine bacilli.
1 animal was inoculated with swine bacilli.

Of the 6 sputum cases: —

1 showed no disease.
2 showed very slight lesions.
3 showed only local lesions without dissemination.

Of the 5 bovine cases: —

2 died of generalized disease.
2 showed extensive lesions.
1 showed less extensive lesions.

In the swine case (probably originally bovine) the lesions were less extensive than in the bovine cases.

In these three experiments the conditions were kept as nearly uniform as was possible, with the means at my disposal. It was unfortunate that an animal as old as No. 88 (bovine IV.) should have been included; it is also to be regretted that the swine culture was about a year old when used upon cattle. Undoubtedly the total absence of any lesions following the injection of the *Nasua* culture is partly due to the age of the culture. Leaving these aside, the remaining parts of the test appear to me to be of sufficient uniformity and accuracy to justify us in drawing certain preliminary inferences. We may now maintain that bovine tubercle bacilli and human bacilli as found in sputum are not identical. The difference in their action upon cattle is reinforced by certain differences in the bacilli themselves and their effect upon rabbits, as will be detailed in a fuller report.

What the significance of these divergencies is, what influence they have upon the transmissibility of the disease from cattle to man, we are unable at present to state with any degree of certainty. That they do have some effect must be admitted, in view of results of studies upon other species of pathogenic bacteria. Their precise bearing needs careful investigation.

These studies will, I think, warrant one inference, however; that is, that human sputum cannot be regarded as specially dangerous to cattle, nor can it be looked upon as a factor in the introduction of tuberculosis into a healthy herd of cattle. Even if the tubercle bacilli of cattle and of man are very closely related and have the same ancestry, as we all must admit, if we regard the two as mere varieties, which may eventually under very favorable conditions pass one into the other, the condition in which the bacillus leaves the lungs in sputum is evidently such as to interfere, *under ordinary circumstances*, with any development in the bovine body. It would fall a speedy prey to destruction.

I refrain, for obvious reasons, from drawing the conclusions that all human tubercle bacilli are like those existing in the sputum of phthisis. On this point we are still in the dark.

The following pages give a concise tabular account of the cultures employed in these investigations, of the animals upon which they were tested and the temperature records of the third experiment. Those of the second experiment, as stated above, reveal no essential differences between the different animals, and are therefore omitted.

Table I.

Designation of Culture.	Source of Culture.	Date when Artificial Cultivation began.	Date of Inoculation into Cattle.	Total Age of Culture. Months.	Total Age of Culture. Days.	Number of Transfer.
Bovine I.,	Old bull (Virginia). Extensive disease, probably of long standing; bones infected.	Dec. 1, 1894,	May 4, 1895,	5	4	3d.
Nasua narica (human sputum),	Household pet of phthisical patient (Washington, D. C.).	July 26, 1894,	May 4, 1895,	9	9	8th.
Sputum II,	Rapid case of phthisis (New Bedford, Mass.),	Nov. 21, 1896,	May 1, 1897,	5	9	8th.
Sputum III.,	Fatal case of phthisis (Norwood, Mass.),	Feb. 15, 1897,	May 1, 1897,	2	15	4th.
Bovine II.,	Old cow with slight lesions of lungs and mediastinal glands (Lawrence, Mass.).	Nov. 28, 1896,	May 1, 1897,	5	2	5th.
Swine I.,	Pig, living under cow barn (Framingham, Mass.),	May 8, 1896,	May 1, 1897,	11	23	16th.
Sputum IV.,	From case of phthisis, subsequently reported as recovered (Melrose, Mass.).	Feb. 16, 1897,	Aug. 26, 1897,	6	10	7th.
Sputum V.,	From a stationary case of phthisis (New Hampshire),	July 7, 1897,	Aug. 26, 1897,	1	19	3d.
Sputum VI.,	From a case of phthisis (Winthrop, Mass.), subsequent history unknown.	July 14, 1897,	Aug. 26, 1897,	1	12	3d.
Bovine III.,	Cow with advanced tuberculosis of lungs and liver (Carlisle (?), Mass.).	April 19, 1897,	Aug. 26, 1897,	4	7	5th.
Bovine IV.,	Cow with slight disease of dorsal mediastinal glands (Billerica, Mass.).	April 23, 1897,	Aug. 26, 1897,	4	3	5th.
Bovine V.,	Cow with moderate lesions of lungs and portal gland (Carlisle, Mass.).	April 23, 1897,	Aug. 26, 1897,	4	3	5th.

TABLE II.

Amount of Suspension of Bacilli injected.	Designation of Culture.	Age of Culture used.	Designation of Animal.	Age, etc.	Original Weight.	Final Weight.	Date of Inoculation.	Result.
		Days.			Pounds.	Pounds.		
4 cc., . .	Bovine I, .	10	No. 284,	Heifer, 2½ years old; common stock, pregnant.	?	?	May 4, 1895, .	Died in thirty-five days, of general miliary tuberculosis.
4 cc., . .	*Nasua narica*,	10	No. 300,	Heifer, 2½ years old, . .	?	?	May 4, 1895, .	Killed June 27, 1895; no lesions.
2 cc., . .	Sputum II., .	9	No. 2616,	Yearling, ...	520	580	May 1, 1897, .	Killed July 1, 1897; lesions very slight.
2 cc., . .	Sputum III., .	9	No. 2634,	Yearling, ...	410	480	May 1, 1897, .	Killed July 1, 1897; lesions very slight.
2 cc., . .	Bovine II., .	9	No. 2635,	Heifer, 2½ years old, . .	650	710	May 1, 1897, .	Killed July 1, 1897; extensive pearly disease in thorax and abdomen.
2 cc., . .	Swine I., .	13	No. 2672,	Heifer, 2 years old, . .	620	660	May 1, 1897, .	Killed July 1, 1897; well marked pleural tuberculosis, with invasion of lymph glands.
2 cc., . .	Sputum IV., .	9	No. 79,	Yearling, about 1½ years old.	525	610	Aug. 26, 1897, .	Killed October 27; abcess in lungs at point of injection, new vascular tissue on ribs and lungs.
2 cc., . .	Sputum IV., .	9	No. 39,	Cow, 4 years old, . .	675	750	Aug. 26, 1897, .	Killed October 27; lesions same as preceding.
2 cc., . .	Sputum VI., .	9	No. 76,	Cow, 3 years old, . .	865	950	Aug. 26, 1897, .	Killed October 27; lesions same as preceding.
2 cc., . .	Bovine III., .	9	No. 71,	Bull, yearling, . . .	645	575*	Aug. 26, 1896, .	Died September 12; miliary tuberculosis of lungs, liver.
2 cc., . .	Bovine IV., .	9	No. 88,	Cow, about 12 years old, .	850	850	Aug. 26, 1897, .	Killed October 27; many minute tubercles in lungs, tuberculous deposits on pleura.
2 cc., . .	Bovine V., .	9	No. 63,	Cow, about 6 years old, .	875	870	Aug. 26, 1897, .	Killed October 27; disseminated tuberculosis of lungs and spleen.

* Two days before death.

TABLE III.

DATE.	Bovine Series (Number of Animal).			Sputum Series (Number of Animal).			Remarks.
	71	86	63	39	76	79	
	Temp.	Temp.	Temp.	Temp.	Temp.	Temp.	
Aug. 24, 11.30 A.M.	101.4	101.2	101.8	101.8	100.0	102.0	– –
25, 11.30 "	101.2	101.8	101.8	101.2	101.8	101.2	– –
26, 1 P.M.	102.8	101.4	101.6	101.8	101.4	100.8	Inoculation 9.10 A.M.
27, 1 "	104.6	102.6	105.4	101.8	103.8	102.6	– –
28, 1 "	104.0	101.6	105.2	102.0	102.4	102.4	– –
29, . .	–	–	–	–	–	–	– –
30, 1 P.M.	103.4	106.0	104.2	101.4	101.8	102.6	– –
31, 1 "	102.8	108.0	105.0	101.2	102.0	102.8	B.* Probably out in morning to date although record not kept.
Sept. 1, 1 "	103.4	105.6	104.0	102.4	103.8	102.0	S.† Out in morning.
2, 1 "	102.0	103.4	103.2	101.2	101.0	101.4	– –
3, 1 "	103.2	101.0	103.2	101.8	101.4	101.2	S.† Out in morning.
4, 1.30 "	105.4	103.4	104.4	101.0	100.6	100.8	S.† " "
5, . .	–	–	–	–	–	–	– –
6, 1 P.M.	107.0	100.8	102.2	100.6	100.8	101.0	– –
7, 1 "	106.6	101.2	105.6	100.4	100.6	100.6	B.* Out in morning.
8, 1 "	107.8	102.4	102.8	101.2	101.0	102.0	S.† " "
9, 1 "	107.2	105.4	104.6	101.4	101.4	102.6	S.† " "
10, 1 "	107.0	104.4	103.0	102.0	102.4	104.4	S.† " "
11, 1 "	104.8	105.0	104.0	101.4	101.2	101.6	S.† " "
12, . .	–‡	–	–	–	–	–	– –
13, 1 P.M.	–	103.0	102.0	101.0	101.2	101.6	S.† Out in morning.
14, 1 "	–	102.4	102.6	101.4	101.0	102.6	S.† " "
15, 1 "	–	101.0	101.8	101.0	101.4	102.0	S.† " "
16, 1 "	–	101.4	101.0	101.6	102.0	102.6	S.† " "
17, 1 "	–	100.4	100.4	100.8	101.4	101.6	S.† " "
18, 1 "	–	99.8	99.8	101.6	101.4	102.4	S.† " "
19, . .	–	–	–	–	–	–	– –
20, 1 P.M.	–	100.0	100.6	101.2	101.2	101.8	S.† Out in morning.
21, 1 "	–	99.8	100.6	101.0	101.2	101.6	S.† " "
22, 1 "	–	99.2	99.0	101.2	100.8	101.6	S.† " "
23, 1 "	–	99.8	101.0	101.0	101.2	101.6	S.† " "
24, 1 "	–	100.4	100.4	101.2	101.6	102.0	S.† " "

* Bovine case. † Sputum case. ‡ Dead.

TABLE III. — *Concluded.*

DATE.	Bovine Series (Number of Animal).			Sputum Series (Number of Animal).			Remarks.
	71	88	63	29	76	79	
	Temp.	Temp.	Temp.	Temp.	Temp.	Temp.	
Sept. 25, 1 P.M.	–	100.4	99.8	101.2	101.8	101.8	S.† Out in morning.
26, . . .	–	–	–	–	–	–	– –
27, 1 P.M.	–	100.4	98.4	101.0	100.8	101.4	S.† Out in morning.
28, 1 "	–	100.2	100.6	100.4	100.8	101.8	S.† " "
29, 1 "	–	98.8	99.0	100.8	101.0	102.0	S.† " "
30, 1 "	–	101.4	100.4	101.0	101.6	101.6	S.† " "
Oct. 1, 11.45 A.M.	–	99.8	100.6	100.8	101.0	101.8	S.† " "
2, 1 P.M.	–	99.2	100.0	101.0	100.8	101.8	S.† " "
3, . .	–	–	–	–	–	–	– –
4, 1 P.M.	–	99.0	99.0	100.0	100.6	101.8	S.† Out in morning.
5, 1 "	–	99.4	100.2	101.0	101.0	101.8	S.† " "
6, 1 "	–	99.6	101.0	102.4	100.2	101.4	S.† " "
7, 1 "	–	99.0	100.2	100.0	101.2	101.6	S.† " "
8, 1 "	–	99.0	100.8	100.2	99.8	101.8	S.† " "
9, 1 "	–	99.2	100.8	100.4	101.0	101.8	S.† " "
10, . .	–	–	–	–	–	–	– –
11, 1 P.M.	–	100.0	98.8	99.8	100.0	100.8	S.† Out in morning.
12, 1 "	–	100.2	100.8	100.6	101.4	101.4	S.† " "
13, 1 "	–	100.2	100.4	100.6	100.8	101.4	S.† " "
14, 1.30 "	–	99.8	99.8	100.2	100.8	101.4	S.† " "
15, 1 "	–	100.2	100.4	100.4	101.8	101.4	S.† " "
16, 1 "	–	100.8	101.8	101.4	102.0	101.8	S.† " "
17, . .	–	–	–	–	–	–	– –
18, 1 P.M.	–	97.2	97.8	100.8	100.6	101.2	S.† Out in morning.
19, 1 "	–	100.4	100.2	100.8	99.0	100.8	S.† " "
20, 1 "	–	101.8	100.0	100.0	99.0	100.6	S.† " "
21, 1 "	–	98.8	101.4	101.0	99.0	100.8	S.† " "
22, 1 "	–	100.0	102.0	100.2	98.8	100.2	S.† " "
23, 1 "	–	100.6	101.4	96.8	99.4	100.4	S.† " "
24, . .	–	–	–	–	–	–	– –
25, 1 P.M.	–	100.0	100.4	99.4	99.0	100.4	S.† Out in morning.
26, 1 "	–	100.6	100.8	99.4	98.8	100.8	S.† " "

† Sputum case.

INDEX.

PUBLIC DOCUMENT . . . . No. 60.

SEVENTH ANNUAL REPORT

OF THE

DAIRY BUREAU

OF THE

MASSACHUSETTS BOARD OF AGRICULTURE,

REQUIRED

UNDER CHAPTER 412, ACTS OF 1891.

JANUARY 15, 1898.

BOSTON:
WRIGHT & POTTER PRINTING CO., STATE PRINTERS,
18 POST OFFICE SQUARE.
1898.

Dairy Bureau — 1897–98.

D. A. HORTON, Northampton, *Chairman.*

GEO. L. CLEMENCE, Southbridge.

J. L. ELLSWORTH, Worcester.

Executive Officer.

W. R. SESSIONS, *Secretary of the State Board of Agriculture.*

Assistant to the Secretary and Acting Executive Officer, appointed by the Governor.

GEO. M. WHITAKER, Boston.

REPORT.

The membership of the Dairy Bureau has continued through the year the same as at the time of our last report, Mr. J. L. Ellsworth of Worcester having been reappointed. The active executive work has continued under the charge of George M. Whitaker, who has been reappointed for another biennial term. The statute title of this position is very misleading. The Bureau has had in its employment during the year three agents, the same ones previously reported, Messrs. J. W. Stockwell, George F. Baldwin and Charles C. Scott. Dr. Charles Harrington, the Boston milk inspector, and his staff are also agents of the Bureau, serving without compensation from the State, in order to promote harmony and efficiency of action. The chemical work has been done by Dr. B. F. Davenport.

Oleomargarine.

The work of the Bureau in enforcing the laws relative to imitation butter has been statistically as follows: —

Number of inspections,	1,986
Samples taken,	212
Cases in court,	26

Of these, in only two instances were the defendants acquitted.

Complaints were made for the following causes: —

Selling or having in possession with intent to sell an imitation of yellow butter,	16
Serving oleomargarine in hotels and restaurants without giving notice,	5
Obstructing officers,	5

The court cases are fewer than last year, but do not represent any diminution in the work. The number of arrests is

not a gauge of the efficiency of a police force. The open selling of deceptive imitation butter has been suppressed, but as the illegal traffic in this imitation product is crowded into more limited quarters, the amount of detective work necessary to secure evidence of a violated law is largely increased. We have this year convicted some persistent violators of the law, in some cases driving them out of the Commonwealth. To bring this about necessitated in some cases weeks of careful work. One case in particular was of more than ordinary interest, and illustrates the difficulties attending the work and the chances that the greed of gain will lead unscrupulous persons to take.

Complaint came to us early in the year from a town in Middlesex County that a peddler had been through the town selling what purported to be Vermont creamery butter at a low price. Samples were secured, analyses made, and the article was found to be oleomargarine, which had been sold as butter from tubs labelled creamery butter, the United States revenue stamps and brands having been removed. We had no knowledge of the name of the party, his residence or his routes, and a number of months' work was necessary in order to supply this information. We found he had several teams and men, and was doing a large business. Then it was necessary to locate him somewhere, and get legal evidence of violation of law from samples whose identity could be positively traced. Then came warrants for his arrest, and, having obtained these, it was again necessary to find where he was to be at some particular time, and to have officers there to serve the papers upon him. We had learned that he was an athletic fellow, given to boasting of his strength, and as a matter of precaution six officers were detailed to surround the house in which he lived, and arrest him. He gave two of the officers a rough-and-tumble chase, but they secured him. Taken into court, he was found guilty, and paid two hundred dollars, other cases being held against him for good behavior. It was not long, however, before he was heard of at his old tricks, and after a number of weeks' work was located and re-arrested. This time he gave two officers a long chase, and was not taken until shots had been fired. Detained in the lockup at South Framingham, he managed to

break out, when he was met by a pal, and the pair rode hastily with one change of horses to Rhode Island, not, however, until the lockup keeper had implanted a bullet in his thigh.

This illustrates some of the difficulties in securing a big statute record. Itinerant peddlers retailing about the State without any particular route, never more than a half day in a place, are hard to get evidence against, and, having secured it, and a warrant, they are hard to re-locate and arrest. An agent working on such a case cannot take many samples or inspect many places of business.

Another reason for the diminution in the number of cases in court is an increased conservatism on our part in multiplying cases, as we find much hesitancy among judges of the district courts to entertain more than one complaint based on one transaction. The first case that we had this year was where (1) a man had sold an imitation of yellow butter; (2) had sold it as butter; (3) had sold it without the proper marks on the tub; (4) had sold it labelled "creamery;" and (5) sold it without the distinctive marks and signs required on the wagon, — a violation of five laws of the State, but only one complaint was made. In nearly every case that we have had this year three or four laws have been violated.

During the past year we have changed our policy relative to the statute under which we have brought cases. Heretofore, recognizing that the sale of oleomargarine as butter and when butter was called for was an unquestioned moral offence, as well as a statutory one, we preferred to bring cases under that law (section 2, chapter 280, Acts of 1894) when possible, feeling that we might appeal more strongly to the court than in a case for selling (or having in possession with intent to sell) an imitation of yellow butter. But experience showed us that as a practical matter we were in error. In the former class of cases we had more to prove. It was not only necessary to show that there had been a sale of an imitation of yellow butter, but it was necessary to prove beyond a reasonable doubt that it was sold in response to a call for pure butter. Not infrequently the defendant would attempt to save himself a fine either by contradicting our

agents outright in denying that butter was called for, or else by claiming that he did not understand, and supposed butterine was called for. In such cases the judge frequently was not convinced beyond a reasonable doubt that the offence charged had been proved. This year we have brought no cases under that statute, although in nine instances the oleo was sold as and for butter; but the complaint made charged that the defendant did sell, expose for sale, or have in his possession with intent to sell —

a certain quantity, to wit, one pound of a certain product commonly called oleomargarine, made partly out of an oleaginous substance not produced from unadulterated milk or cream from the same, and that said product was then and there in imitation of yellow butter produced from pure unadulterated milk or cream of the same.

The evidence in this case is more easily secured, and less easily contradicted. As a result, we have not lost one of these cases. Of the two cases lost, one was for obstructing an officer, in which case our evidence was weak. The other was where oleomargarine had been served for butter in a café connected with a hotel. On the trial of the case the proprietor of the hotel swore that he had leased the café, and was not responsible for its management. Although having no connection with this case, we were much interested in learning, a few weeks after, that the landlord's license to sell intoxicating liquors had been taken from him for violating the provisions of the liquor law.

The great source of our trouble continues to be the State of Rhode Island, which is behind the other New England States in pure-food legislation. The whole system of peddlers and of selling on orders has its headquarters in Rhode Island. In one case the court decided that selling on orders is an evasion of the law,.and the party was convicted. The defence in this case introduced the following: —

DEAR SIR: — You are hereby requested to act as my agent in getting and delivering to me the following merchandise: —

Number
Date
Signature
Number of tub Vermont.

The defence, having submitted this form of order, argued that the purchaser on signing this really made the defendant his agent; and that the defendant, as agent for the consumer, purchased these goods in Rhode Island. The judge held that the circumstances in the case convinced him that the order was a subterfuge, and an attempt to evade the law; consequently he held the defendant, who appealed, but withdrew his appeal and pleaded guilty in the superior court.

Doubtless in some instances oleomargarine is honestly desired. Unquestionably there are persons who from various motives prefer to use a mixture of lard and tallow in place of butter; but when it is sold in imitation of yellow butter, with a misleading name, or by companies with deceptive titles, there is a suspicion that consumers hardly realize what they are buying, and are more or less imposed upon by the deceptive nature of the brand or of the company doing business. In one instance we found that a peddler had been selling the goods marked "Oakdale Standard" as butter to ignorant families who did not know that this expression was the trademark of one of the large oleomargarine dealers. It is possibly true that now and then a person who honestly wants to purchase oleomargarine for legitimate use has been troubled to get it; but where any annoyance has been occasioned in the honest sale of a pound, we believe that the dishonest sale of ten pounds has been prevented. It should be remembered that it is perfectly legal to sell oleomargarine in this State, in a separate and distinct form, and in such a manner as will advise the consumer of its real character. But oleomargarine in that shape is a drug on the market. Its value as a commercial product comes not from the food value which the scientific men may find in it, but from the perfection of the imitation of butter. There is a theoretical oleomargarine of the chemists' laboratory, which has a food value; there is the oleomargarine of commerce, which as an imitation of butter is a constant temptation to swindling, and the temptation is seldom resisted. The supreme court of the United States says of the Massachusetts anti-color law: —

The suggestion that oleomargarine is artificially colored so as to render it more valuable and attractive can only mean that purchasers are deluded by such coloration into believing that they are

getting genuine butter. . . . The statute seeks to suppress false pretenses, and to promote fair dealing in the sale of an article of food. . . . Does the freedom of commerce among the States demand a recognition of the right to practise a deception upon the public in the sale of any articles, even those that may have become the subjects of trade in different parts of the country? . . . If an article compounded of cheaper ingredients can be made so closely to resemble butter that ordinary persons cannot distinguish it from genuine butter, the liability to deception is such that the protection of the public requires those dealing in the article in some way to designate its real character. . . . It is within the power of a State to exclude from its markets any compound manufactured in another State which has been artificially colored or adulterated so as to cause it to look like an article of food in general use, and the sale of which may, by reason of such coloration or adulteration, cheat the general public into purchasing that which they may not intend to buy. The constitution of the United States does not secure to any one the privilege of defrauding the public. The deception against which the statute of Massachusetts is aimed is an offence against society.

The following is a summary of the receipts, exports, stocks and consumption of butter at Boston for the past year, as compared with the year previous: —

	1897. Pounds.	1896. Pounds.
On hand January 1,	2,898,000	1,659,434
Receipts for the year,	51,107,033	50,972,255
Total supply,	54,005,033	52,631,689
Exports, deduct	3,286,333	3,156,741
Net supply,	50,718,700	49,474,948
Stock, deduct.	2,620,680	2,898,080
Consumption,	48,098,020	46,576,868

The above statement shows that the consumption of butter supplied by the Boston market increased about three per cent last year, as compared with the year previous, and averaged about 925,000 pounds per week. If, by having

no laws regulating the sale of imitation butter, oleomargarine had been sold as butter, deceptively, to an amount equalling one per cent of the above consumption, the amount would be 480,980 pounds. We think that this assumption is a moderate one, from what we know of the history of the oleomargarine business, both before and after the passage of the laws, and the tendency to sell the mixture dishonestly. The average wholesale price of fresh-made extra creamery butter has been, during each month for the year, compared with two preceding years: —

	1897. Cents.	1896. Cents.	1895. Cents.
January,	20-22	22-26	24-26
February,	20-22	21-24	22-25
March,	19-23	22-24	20-23
April,	17½-22	16-22	19-21
May,	15½-18	15-17	17-19
June,	15-16	15-16½	18-20
July,	15½-16½	15-16½	18-19
August,	15½-19	15-17½	20-21
September,	18-22	15½-17½	20-22
October,	21-22½	16-20	21-23
November,	21-22	18-21	22-23
December,	21-23	20-23	23-28

If an amount of oleomargarine equal to one per cent of the sales of butter had been sold dishonestly, this amount at 20 cents per pound would equal $96,196 to the credit of the law and its enforcement, leaving out of the account the butter supplied from other commercial centres in the State, like Worcester and Springfield. This is considering only the commercial side of the case, and not recognizing the fraud on the consumer. This fact in itself ought to be a vindication of the law and a proof of its economy.

Many States have patterned after Massachusetts in dairy legislation. Although Massachusetts is not emphatically a dairy State, it has set the pace for the whole country in dairy laws. This is in a measure due to the fact that the first color case to reach the United States supreme court came from Massachusetts, and was handled with such consummate ability by Hon. A. E. Pillsbury as to secure a vindication of the law in a decision from which we have quoted above. Since then many other States have followed our example, and adopted laws almost word for word like those of this State. Probably there is no other matter in which there is so much uniformity in legislation. Some States, however, in enacting this law have provided additional safeguards against the improper sale of a deceitful imitation product, some of which are as follows: —

California declares that any article made in semblance of butter, and designed to be used as a substitute for butter, is an imitation of butter. The use of imitation butter in public or private hospitals, asylums, eleemosynary or penal institutions is prohibited. No common carrier shall receive imitation dairy products for the purpose of forwarding or transporting the same, unless they are properly branded and receipted for under their true name. The use of the word "butterine" is prohibited. Search warrants may be issued for imitation butter or cheese, which may be seized if kept in violation of the law.

The laws of Ohio not only give the dairy commissioner authority to enter any place where dairy products are sold, but go so far as to authorize him to examine the books in such places.

In Minnesota, express agents, railroad officials and employees of common carriers are required to render to the dairy commissioner all the assistance in their power, when so requested, in discovering the presence of any imitation of pure butter or cheese. The commissioner is authorized to seize imitation and adulterated dairy products, and after order of the court sell the same for any purpose other than to be used for food.

Connecticut has a law authorizing the dairy commissioner to inspect the books of transportation companies, in order to trace illegal sales of oleomargarine.

Wisconsin authorizes the issuing of warrants to search places where imitation butter or cheese is believed to be concealed, and provides for the confiscation of such imitation dairy products, and their destruction under the direction of the court or magistrate.

Michigan provides that "the taking of orders or the making of agreements or contracts by any person, firm or corporation, or by any agent or representative thereof, for the future delivery of any of the articles, products, goods, wares or merchandise embraced within the provisions of this act, shall be deemed a sale."

Critics of the oleomargarine laws sometimes raise the point that there is sometimes a departure from strict honesty in handling some grades of real butter. There is no logic in this. If A is guilty of deception, his fault is not lessened because B has also practised deception. It is a fact that there are some things in the butter trade which cannot be wholly approved. But it doesn't help one man out of the mud to find some one else with his coat spattered. The processes for working and renovating low-grade butter have been so perfected as to render the product a satisfactory article for quick consumption; still, as it is ordinarily sold, it is more or less tainted with deception. The product really comes from the cow's udder, but when it is sold as "fresh creamery butter" it is a fraud on the consumer and an injury to legitimate business. This product till recently has been known in the trade as "process butter," and by that name it could be honestly sold, although when it was distributed by the retail trade it frequently became "fresh creamery." Latterly the trade has adopted the name of "sterilized butter," which is not only a misnomer, but deceptive. The word "process" was open to objections, but the expression "sterilized" is even worse. We have had a number of specimens of these kinds of butters analyzed, and in each case the chemist has reported that the product was in some respects unusual, although he was obliged to class it with the pure butters.

We understand that the process of melting and aerating butter and re-working it in fresh milk was begun some seven or eight years ago. From that starting point the business has

extended so that there are large factories in some six or eight different places in the west. We have seen it stated that the total output of these places is fully four hundred tubs a day. The exact method of making these goods is not known. In some cases different firms have varying methods peculiar to themselves, but in a general way the process is something like this: the butter is bought either from farmers or from dealers, melted into oil, carefully strained, then aerated by pumping currents of air through it, and finally chilled by dropping onto ice or a cold surface. The granules are then churned with milk, and the product is salted, worked and packed. Fair flavor and character are the rule, but, having been once melted, the butter is peculiarly sensitive, and quickly loses its freshness; some lots become tallowy. We have a suspicion that some dishonest manufacturers may mix in more or less tallow and lard in the process of manufacturing this "sterilized" butter. We found one sample in the hands of a reputable retail grocer which was unquestionably oleomargarine. We were able to trace the shipment with such directness through a leading Boston wholesaler to a large Chicago manufacturer that we felt no end of justice would be promoted by a prosecution in this State. The facts, however, were placed in the hands of the Illinois authorities for further investigation.

Milk.

More attention has been given to milk than any previous year. Two hundred and thirteen samples have been taken, though only one case was put into court. In this the milk was actually adulterated, but it was lost by a ruling on a law point by an associate justice of the court sitting during the vacation season. A transportation corporation had a café at one of its stations, and served adulterated milk. Samples taken tested 10.42 and 8.14 per cent of milk solids. The manager of the café was complained of, and his attorney raised the point that, under the statute holding responsible either the principal or his agent or servant, we could hold the corporation itself or the waiter who served the adulterated milk; but the attorney argued that the manager of whom we had complained was neither the servant who sold

the adulterated milk nor the principal. The justice ruled that, as the manager of the café was not personally present at the time that the waiter served the milk, he was not responsible. Another case was brought before the regular justice of the court at the conclusion of the vacation season, but by this time the defendant had left the State and could not be found.

The agricultural papers and scientific men have been discussing the idea of a statute standard of milk to an unusual extent during the past year. The principle is well established in Massachusetts, and is endorsed both by consumers and producers. Farmers' organizations have time and time again passed resolutions favoring it. Many cows produce milk of less than 13 per cent solids, but they are a minority. The Massachusetts law says milk below 13 per cent — with an exception of some summer months — is not "of standard quality," and is therefore unmerchantable as standard milk. One critic says: "What the farmer needs and has a right to ask is that the law shall not step in and try to punish him because the Creator did not make all cows alike." This is a misapprehension of the spirit of the law. Milk of standard price must be of standard quality. The opposition to the law has hitherto been largely from men whose cows produced milk poorer than the average, and who wanted to sell this poorer milk as standard milk. These persons, under the fallacious pretext that cows could not give as good milk in the summer as in winter, have succeeded in getting the very generous exception of five months in which 12 per cent is declared to be standard milk. This assertion about summer milk is not founded on fact. Mr. Clemence of the Dairy Bureau has for several years made occasional tests — usually about once a month — of the mixed milk of his herd, mostly grade Shorthorns, and he has not only found it fully up to the standard, but he has found it very uniform in quality, varying less than .4 of 1 per cent, and usually less than .2 of 1 per cent, from month to month. Many similar experiments are on record. The most recent is from the New Jersey Experiment Station. The herd there consisted of 28 cows; 23 were of mixed breeding, with 2 each of Holstein and Guernsey blood and 1 Jersey. From 18 to 26

cows were milked each month. Each month except one several fresh cows were introduced, as many as 4 each in September and March. The following is the average per cent of fat in the mixed milk (fat is the most variable element of milk, and the one that governs its quality): —

May,	4.2	November,	4.2
June,	4.3	December,	4.2
July,	4.3	January,	4.3
August,	4.4	February,	4.1
September,	4.3	March,	4.0
October,	4.4	April,	4.1

This shows the constant quality of herd milk, and that there is no marked seasonable falling off during any particular month or months.

The present attack on the statute standard comes from persons who preach that milk should be sold according to quality. With this contention we are in sympathy, and believe that milk will be sold that way in the future. There is no sense in selling 10 or 13 or 16 pounds of food all at the same price. But the advance step should not be taken at the expense of losing any of the advantages of the present law. We hardly think that the times are yet ripe for such a change, as, from the stand point of those having some experience in enforcing the law, it would let in a large amount of adulteration.

Laws against adulteration seem as yet to need a standard. Wealthy or intelligent people could discover fraud in milk, but the ignorant would suffer imposition, and the poor might be comparatively helpless.

There is nothing in the law now to prevent milk being sold on its merits in three grades; 1st, extra; 2d, standard; 3d, skimmed.

A man with Jersey or Guernsey stock is now at liberty to make a 14 or 15 per cent milk, grade it as extra, guarantee its extra quality, and sell it at an extra price if he can find customers. On the other hand, milk low in solids can be sold at a low price by labelling it skimmed milk, — which in some instances is not far from the truth.

We hope to see many enterprising dairymen try this experiment of selling extra milk at an advance from the going

price. This ought to prove advantageous to them, and also an education to the public, being an object lesson of the differing values of milk. It would thus serve to bring nearer the time when it may be expedient to change the laws relative to the statute standard.

The following is the result of some analyses of milk taken from milkmen by officers of the State Dairy Bureau in the regular discharge of their routine duties, and throws an accurate side light on the per cent of solids sold. These samples were taken in May and June.

Worcester.

Milkman No. 1,	12.84	Milkman No. 15,	13.48
No. 2,	12.88	No. 16,	13.64
No. 3,	12.20	No. 17,	14.08
No. 4,	12.60	No. 18,	14.02
No. 5,	12.76	No. 19,	12.62
No. 6,	13.00	No. 20,	14.22
No. 7,	14.34	No. 21,	12.52
No. 8,	12.40	No. 22,	12.12
No. 9,	14.22	No. 23,	13.78
No. 10,	12.04	No. 24,	12.40
No. 11,	13.26	No. 25,	12.92
No. 12,	12.84	No. 26,	13.02
No. 13,	12.00	No. 27,	12.52
No. 14,	12.90	No. 28,	14.32

Taunton.

Milkman No. 1,	14.14	Milkman No. 4,	14.28
No. 2,	12.54	No. 5,	13.54
No. 3,	13.02		

New Bedford.

Milkman No. 1,	12.48	Milkman No. 16,	13.36
No. 2,	12.64	No. 17,	14.30
No. 3,	12.18	No. 18,	12.80
No. 4,	13.42	No. 19,	15.02
No. 5,	13.10	No. 20,	13.90
No. 6,	11.84	No. 21,	13.54
No. 7,	14.00	No. 22,	13.60
No. 8,	12.98	No. 23,	12.74
No. 9,	12.52	No. 24,	13.36
No. 10,	13.08	No. 25,	13.26
No. 11,	13.66	No. 26,	13.84
No. 12,	13.88	No. 27,	12.64
No. 13,	13.90	No. 28,	12.82
No. 14,	14.60	No. 29,	13.46
No. 15,	13.40	No. 30,	12.82

These samples were taken at summer resorts during July and August: —

No. 1,	12.72	No. 18,	11.76
No. 2,	18 04	No. 19,	12.36
No. 3,	16.96	No. 20,	12.36
No. 4,	12.56	No. 21,	11.34
No. 5,	8.14	No. 22,	10.42
No. 6,	13.74	No. 23,	14.10
No. 7,	14.06	No. 24,	12.51
No. 8,	12.22	No. 25,	11.10
No. 9,	12.46	No. 26,	10.78
No. 10,	12.84	No. 27,	10.28
No. 11,	14.16	No. 28,	12.46
No. 12,	12.40	No. 29,	11.48
No. 13,	12.84	No. 30,	16.26
No. 14,	12.48	No. 31,	12.46
No. 15,	19.02	No. 32,	12.86
No. 16,	15.46	No. 33,	12.14
No. 17,	12.54		

The samples of abnormally high milk, 19, 18, 16, per cent etc., were probably cases where there was carelessness in properly mixing the milk, and the samples which our agent happened to get were taken from the top of the can or tank. In those cases we notified the parties, recommending more care in mixing, for the person who would be served with milk from the bottom of the can or tank would have that which was correspondingly poor.

In the cases of milk which tested low we took a second sample to strengthen our position, and in every case but one the second sample was an improvement on the first, confirming still further our theory that there exists too much carelessness about properly agitating and mixing the milk. In the one exception, to which allusion is made above, the sample taken at the first visit of our agent tested 10.28, and that taken at a second visit tested 8.14.

The principal critics of the law come largely from towns which have shipped milk for many years to Boston, where there is none of the tonic that comes from producer meeting consumer, and where cows have been bred for large quantities rather than for quality.

During the past year the newspapers have reported an increased attention to the sanitary phases of the milk question.

Medical and health bodies have been discussing them, and considering possible legislation. It is a fact that legislation has hitherto looked more after the commercial fraud of selling adulterated milk, or milk not of standard quality, than it has at the health phases of the case. It is also a fact that the modern advances in bacteriology have given definite and accurate data on which we can now base intelligent and advanced action. Hence there is a good opportunity for Massachusetts to take a forward step, and for the Legislature to do something looking to enhancing the quality of the State's milk supply. But such legislation should be discreet, and should, especially at the outset, guard against steps too far in advance of the ideas of producers, or which might tend to the annoyance of petty officialism. Michigan has a system of inspection which merely leads to publishing reports of what the inspectors find. The publicity of these reports is expected to work a correction of the evils noticed. A measure as mild as this ought not to arouse great opposition, and yet it would be strong enough to have a beneficial educational influence which would tend to correct evils now existing so far as producers are concerned. A favorable report would be a good advertisement of any producer. Any filthy or unsanitary conditions at the city end of the business among wholesalers or peddlers would require different action. I submit herewith a few samples of the results of Michigan inspection, as taken from printed reports of the dairy commissioner of that State: —

At Lowell.

R. Rider. — Cows clean; stables clean; ventilation good; sanitary conditions fair; uses well water.

J. Kramer. — Cows fairly clean; stables unclean; ceilings dusty and floors dirty; ventilation good; sanitary conditions very poor; uses spring water.

At Howard City.

A. S. Stodard. — Cows poor but fairly clean; ventilation poor; sanitary conditions fair; uses well water.

William O'Donald. — Cows clean; stables unclean; ventilation good; sanitary conditions fair; uses creek water.

At Big Rapids.

C. E. Draper. — Cows clean; stables clean; ventilation fair; uses well water.

M. Boynton. — Cows clean and in good condition; stables very unclean; ventilation fair; sanitary conditions poor; well water used.

A. Card. — Cows clean; stables low and extremely dirty; drainage poor; ventilation poor; sanitary conditions very bad.

At Cadillac.

C. J. Holman. — Stables unclean; drainage imperfect and manure allowed to accumulate near stables; ventilation fair; sanitary conditions poor.

E. N. Reynolds. — Stables fairly clean; ventilation fair; sanitary conditions poor; uses lake water.

M. Berridge. — Cows clean; stables clean; ventilation good; sanitary conditions of stables good, of yard poor; well water used.

At Belding.

C. E. Lewis. — Cows fairly clean; stables fairly clean; ventilation good; sanitary conditions poor; well water used; was feeding garbage from the house.

H. C. Angel. — Cows clean; ceilings of stables dirty; drainage poor; ventilation good; sanitary conditions of yard very bad; uses spring water.

G. C. Devine. — Cows part clean and part dirty; stables clean; ventilation good; sanitary conditions of yard poor; uses well water.

At Ionia.

A. M. Welch. — Cows in very good condition; stables exceptionally clean; ventilation good; sanitary conditions excellent; uses spring water; drainage good. Cows are cleaned twice a day; wells and ceilings of stables whitewashed twice each year; has clean, well-ventilated cooling room, and all modern appliances for handling milk in a neat and systematic way.

W. D. Place. — Cows clean; stables low, with clean floors but dusty ceilings; ventilation poor; sanitary conditions poor; uses creek water.

H. Jackson. — Cows part clean and part dirty; stables unclean: drainage poor; stables exposed to open scaffolding; ventilation fair; sanitary conditions poor; uses creek water. Manure is allowed to accumulate near barn.

A. E. Jackson. — Cows part clean and part dirty; stables unclean; drainage poor; ventilation fairly good; sanitary conditions poor; uses creek water.

G. Percival. — Cows part clean and part dirty; stables unclean, ventilation good; sanitary conditions poor; uses cistern water.

L. A. Cornell. — Cows clean and in good condition; stables in poor condition; ventilation poor; sanitary conditions of yard poor.

M. S. Sprague. — Cows fairly clean; stables unclean; ventilation fair; sanitary conditions poor; uses river water.

During the past year considerable time has been given by the acting executive officer of the Bureau to work in connection with the milk business in the "Greater Boston." This is a phase of dairying which last year sent over the railroads 11,798,191 cans of milk, — an average of 32,320 cans per day. If the farmers received on an average 20 cents per can, we have here an industry amounting to $2,359,628 to the producers. The retail price in the cities varies considerably under different circumstances. Milk is being sold more and more in the grocery stores, and at a cut price. In not a few stores it is sold at less than cost, as a bid for other trade. We find retail sales made at all the way from 4 to 7 cents per quart. If we consider 6 cents an average price, the sales, which were 8,788,000 cans, amount to $4,456,000. These figures relate only to the milk that is brought into the city by railroad by the large milk wholesalers. Other statistics are not available, because the milk is brought in in different ways. It is generally believed — and the best information that we can get confirms it — that over 25, almost 30, per cent more comes in by wagons from near-by territory. Dr. Harrington has kindly given me a list, showing that 5,232 cans daily are brought into the municipality of Boston. The competition of this wagon milk and of railroad milk has been very sharp this year. If, of the amount of milk sold by the wholesalers, the amount of adulteration should equal 1 per cent of the sales, it would amount to 87,385 cans of milk. From the stand-point of the consumer, at the average price of 6 cents per quart this means $35,566 paid unjustly for water, — a $35,000 steal. From the stand point of the producer, netting on an average 20 cents per can, it means a wrong of $17,477. This amount could be easily doubled were we to take in the whole State, with such thrifty, grow-

ing cities as Lawrence, Springfield, New Bedford, Holyoke, Taunton, Fitchburg, Gloucester and others. No one would for a moment argue but what, were it not for the existing laws and the way they are enforced, the percentage of adulteration would be much more than 1 per cent.

The figures below give the amounts of receipts and sales of railroad milk — in 8½ quart cans — as reported by the wholesalers' association during the year of 1897, also the figures of previous years, for purposes of comparison: —

	Received.	Sold.	Surplus.
January,	923,852	705,324	218,528
February,	835,115	639,952	195,163
March,	960,084	719,814	240,270
April,	976,996	733,298	243,698
May,	1,105,325	759,875	345,450
June,	1,115,234	752,038	363,196
July,	1,013,552	789,849	223,703
August,	966,058	720,374	245,684
September,	956,445	732,795	223,650
October,	1,037,764	751,944	285,820
November,	962,552	708,459	254,093
December,	945,274	724,850	220,364
Total,	11,798,191	8,738,572	3,059,619

	Receipts.	Sales.	Surplus.
1896,	10,772,108	8,087,378	2,684,730
1895,	9,856,500	8,040,732	1,815,768
1894,	9,705,447	7,657,421	2,048,026
1893,	9,263,487	7,619,722	1,643,765
1892,	9,212,667	7,315,135	-

The three million cans of surplus milk have been kept off the milk market by the contractors, thereby tending to steady the price and keep it more uniform than if the whole product was placed upon the market to be sold for what it would bring, as is the case with other articles of merchandise. This surplus kept off from the market has been made into butter by the wholesalers, and they return to the farmers the average jobbing price of butter, less the charge for manufacturing. This surplus milk has averaged to net the farmers 13.33 cents per can during the year. The lowest price was received in May, June and July, 11 cents per can; the highest in December, 15.34 cents. The price received for sale milk is the same as last year. It has been kept quite uniform from year to year, by the system in which Boston milk is handled. The price of surplus milk depends upon the market value of butter, and has averaged one-third of a cent more for 1897 than it did for 1896.

For the months of April, May, June, July, August and September, the price to the farmers at their several railroad stations was 19 to 26 cents per 8½ quart cans. During the other months of the year, January, February, March, October, November and December, the price ranged from 21 to 28 cents. This range of prices is adjusted by an agreement between the producers and the wholesalers that the price shall decrease by a regular system as the distance from the city and the cost of transportation increases.

We present herewith a plan illustrating this. The vertical parallel lines represent the railroads over which milk is shipped, drawn as air lines. We have marked on each one the location of each milk-shipping station, and its relative distance from Boston as the railroads run. We have drawn across this map horizontal lines, showing the belts of the different prices. If the arrangement above alluded to between the producers and the wholesalers was lived up to literally, these horizontal lines in all cases would be complete and exactly parallel with each other. In some cases it is necessary to depart from the literal application of this rule, as where milk is taken from a branch road which crosses the main line on some other route. For instance, milk is brought to Boston from Barre by the direct line of the Cen-

tral Massachusetts, and also over the Boston & Albany road. By one way Barre is 108 miles from Boston, and by the other 64. But it would be difficult to pay different prices at the same place, and the 64-mile price must govern. These variations from the schedule are noted by dotted lines about the towns affected.

The milk laws of other States contain some interesting suggestions.

Minnesota prohibits the keeping of cows for the production of milk for market or for manufacturing the same into articles of food "in a crowded or unhealthy condition." The dairy commissioner is required to furnish all the dairies shipping milk to the city, and all the peddlers or venders of milk in the cities within the State, with blanks for the purpose of making a report of the amount of milk and dairy goods handled, "and all milk dairies, milk venders and milk peddlers shall send to the State food and dairy commissioner quarterly reports of all the business done by each and every such person, firm or company in handling dairy products during the last three months past, as designated under the different headings of printed blanks. No person shall sell or offer for sale any cream that contains less than 20 per centum of fat."

Minnesota is the only State, so far as we know, that has a law relating to clean cans. It is as follows: "Any person, persons, firm or corporation who receives any milk or cream in cans, bottles or vessels which have been transported over any railroad or boat line, where such cans, bottles or vessels are to be returned, shall cause the said cans, bottles or vessels to be emptied before the said milk or cream contained therein shall become sour, and shall cause the said cans, bottles or vessels to be immediately washed and thoroughly cleansed and aired."

Wisconsin authorizes its dairy commissioner to make regulations when needed concerning the cleanliness of utensils, rooms, buildings, etc., used in the sale of dairy products.

Chapter 425, Acts of 1894, is as follows: "No producer of milk shall be liable to prosecution on the ground that the milk produced by him is not of good standard quality, unless the milk alleged not to be of such quality was taken

upon the premises or while in the possession or under the control of the producer by an inspector of milk or by the agents of the Dairy Bureau or State Board of Health, or collector of samples duly authorized by such inspector, and a sealed sample of the same given to the producer."

This was enacted in the expectation that it would in some way save innocent farmers from any hardship growing out of the enforcement of the milk laws. It has not accomplished any such purpose, but has hindered the prosecution of those who have sold adulterated milk.

Chapter 264, Acts of 1896, section 1, says: "No person shall sell or offer for sale or exchange, in hermetically sealed cans, any condensed milk or condensed skim-milk, unless in cans which are distinctly labelled with the name of the person or company manufacturing said condensed milk or skim-milk, the brand under which it is made, and the contents of the can."

The Bureau has been asked during the year to pass upon the meaning of the word "contents," in the last line. The popular opinion prevailed that it required either the weight or the analysis of the contents. The question was referred to the Attorney-General, who held that the word refers back to the words "condensed milk or condensed skim-milk," in the second, fourth and fifth lines, and that the law would be complied with if the can should be labelled "condensed milk," or "condensed skim-milk," as the case might be. This seems to take out of the law what seems to be its spirit.

Ohio has a law which requires that the proportion of milk solids contained in condensed milk shall be in amount the equivalent of 12 per cent of solids, in crude milk, and of such solids 25 per cent shall be fat. Condensed milk cannot be sold in that State unless the same is made from unadulterated and wholesome milk from which the cream has not been removed.

In view of the great variation in the quality of condensed milk, and its increasing use, similar legislation may be needed in this State.

The sale of cream is increasing. Maine is the principal source of the cream in the markets of Boston and other